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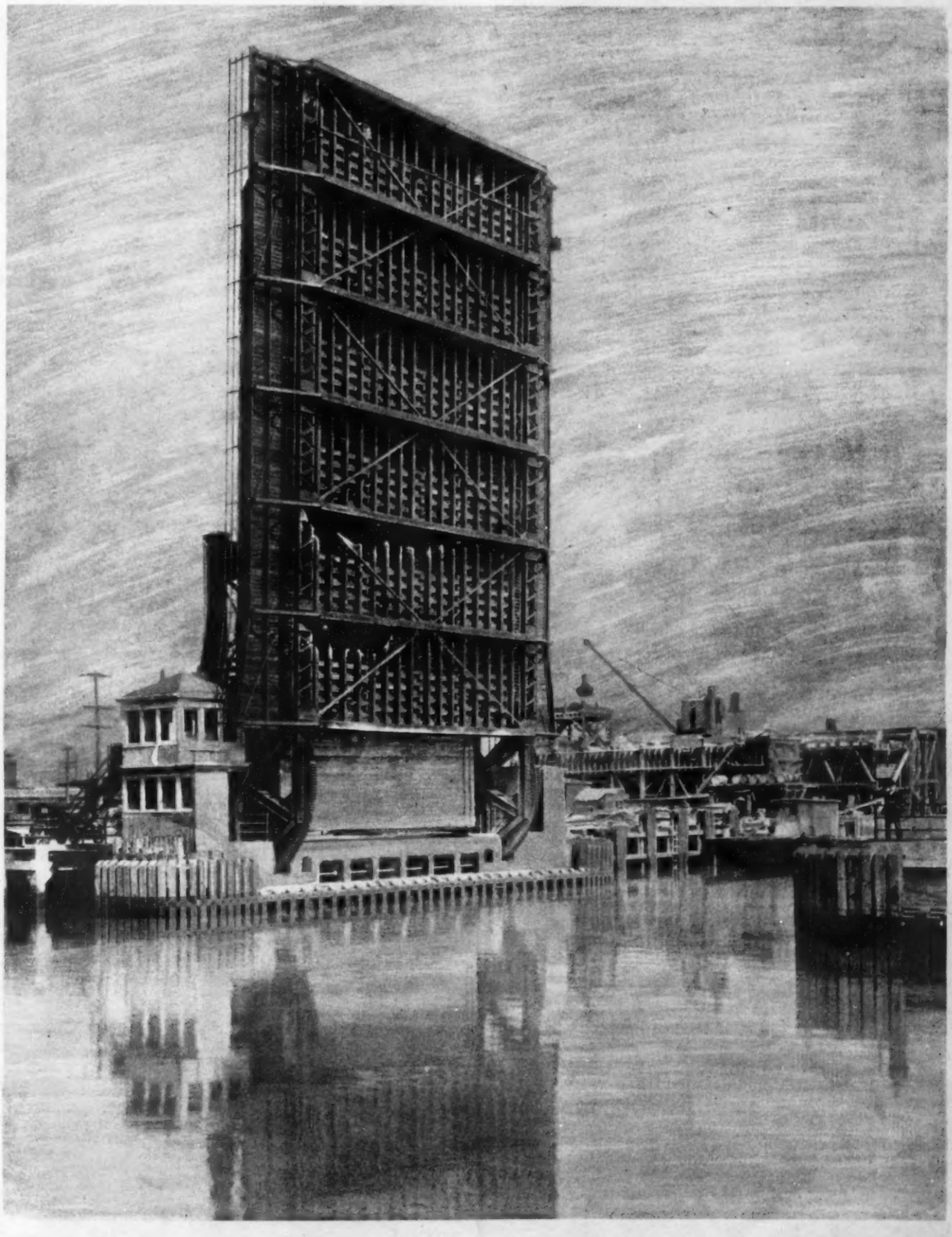

A LIFT BRIDGE EQUIPPED WITH NUMEROUS, NOVEL SAFETY DEVICES [See page 143]

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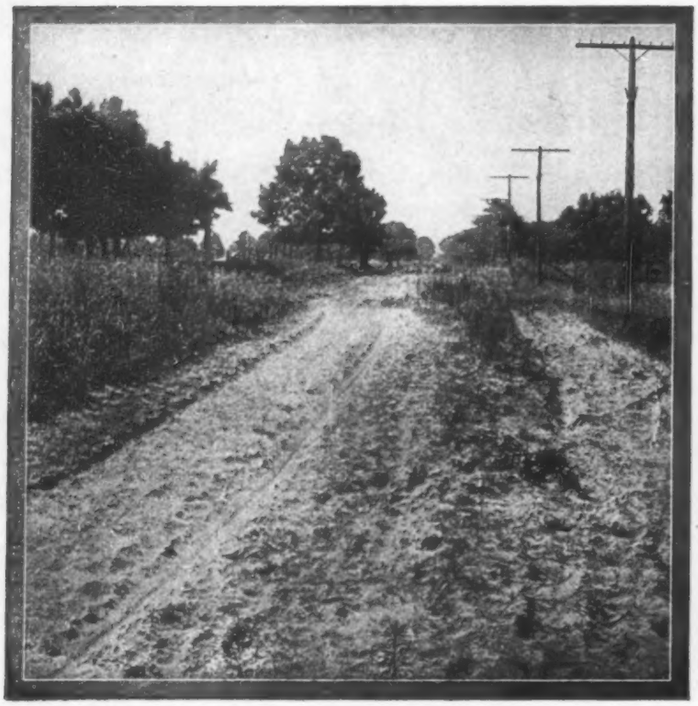

An actual photograph of a part of the Dixie Highway, Illinois, before Tarvia was used.

The same road showing what the use of "Tarvia-X" has done. Note smooth, dustless surface.

How *One* Man Carried the Bond Issue—

A well-known county engineer tells this story, and *it's the best good-roads story we ever heard.*

He says the county was in terrible need of better roads. The mud all through the district was so deep that it was impossible to use wagons, all traveling being done either on foot or horseback.

In spite of the need there was little enthusiasm for good roads when the Board of County Commissioners met. Everyone was afraid of the presumed *high cost and increased taxes.*

A farmer in the back of the room arose.

"Mr. Chairman," he said, "I ain't fit to address a dignified meeting like this, but that's because I've had to travel for ten miles over the kind of roads you give us.

"I couldn't drive, I had to ride horseback.

"My boots are covered with mud; my trousers are covered with mud; my coat is covered with mud; my hat is covered with mud; and if I hadn't stopped to wash it my face would be covered with mud, too.

"I look as if I had crawled here on my hands and knees, and I'm only half through because I've still got to go back, with five dollars' worth of groceries that I bought from brother Fletcher.

"If there had been a good, hard road that my old horse could climb up and draw in a load of lumber that I've got ready, I would have bought twenty-five dollars' worth of groceries instead of five dollars' worth, and there would have been that much more money in town tonight."

And the mud-covered farmer sat down!

Other speakers took up his case. They pointed out that good roads were an *asset* instead of a *liability;* an *economy* instead of an *expense;* that they brought money into a town and greatly increased the markets.

The result was that the Commissioners enthusiastically passed a resolution to issue bonds enough to give them several miles of good roads.

Today the county is more prosperous than ever, school conditions are better and the amount of traffic going in and out of the town has increased several hundred per cent.

The old-time hostility to good roads by taxpayers is fast passing away. Mud holes may look cheap, but they are the costliest thing any community can have around.

If you will build and maintain your roads with Tarvia you will have dustless, mudless, frost-proof highways that cost little to construct and maintain.

Tarvia has removed the last obstacle to the Good-Roads Movement because its use insures *good roads at low cost.*

Tarvia

Preserves Roads-Prevents Dust

Special Service Department

In order to bring the facts before taxpayers as well as road authorities, The Barrett Company has organized a Special Service Department which keeps up to the minute on all road problems. If you will write to the nearest office regarding road conditions or problems in your vicinity, the matter will have the prompt attention of experienced engineers. This service is free for the asking.

If you want *better roads* and *lower taxes,* this Department can greatly assist you. Booklet free on request.

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The Electrical World recently said, "That good lighting helps to build up esprit de corps seems undebatable. The men are happier, take more pride in their work and in the appearance of the shop, and generally do better all around when the light is good."

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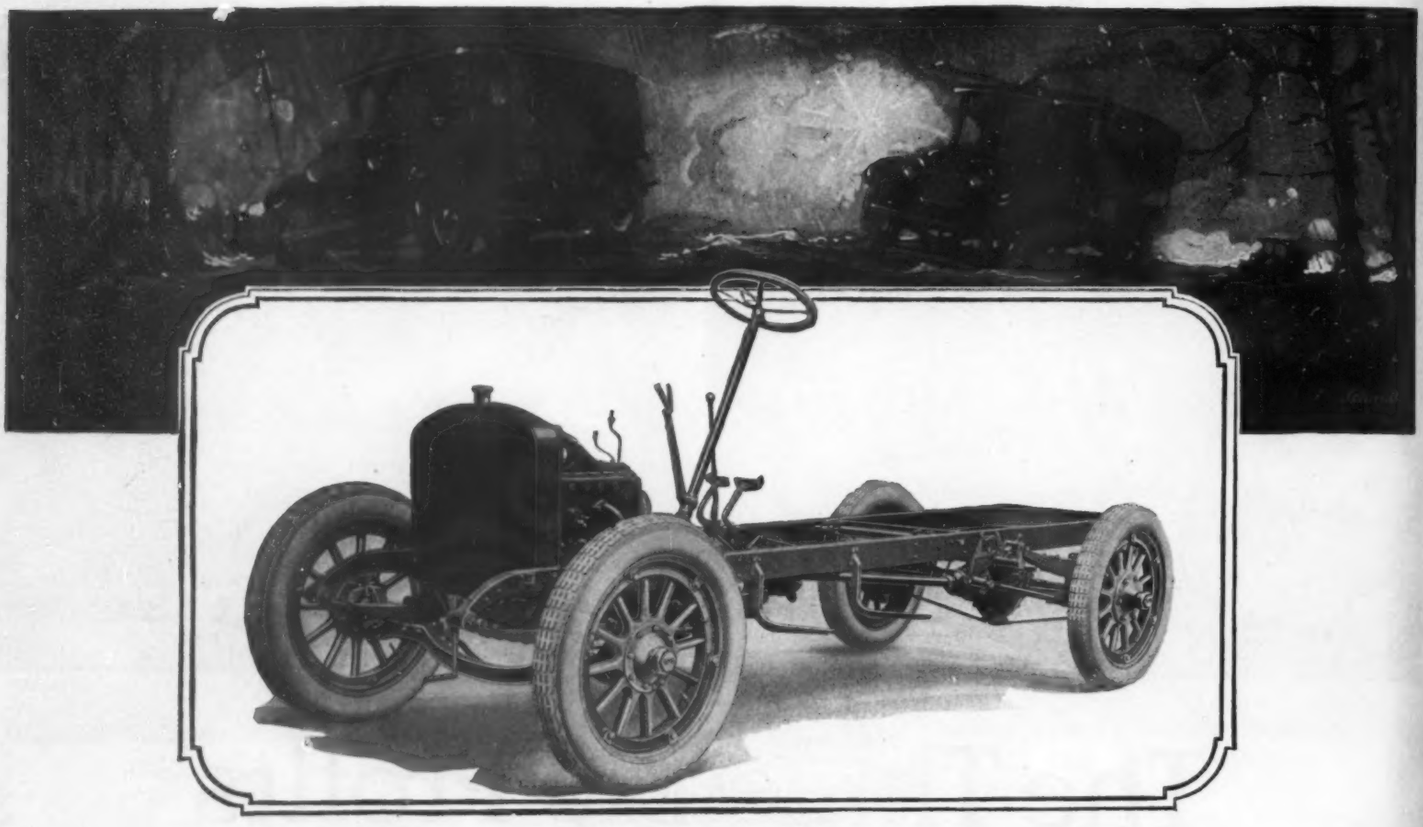

One Government Act Tells the GMC War Story

One Official act of the United States Government tells in the simplest way the outstanding story of GMC trucks in war.

When the War Department sought to solve the problems growing out of too many models in motor transport, standardized truck sizes resulted.

Where no commercial model could be found to fit the exacting requirements, government specifications supplied the lack.

When it came to the ¾—1 ton truck there was a commercial chassis ready-built.

It was the GMC Model 16.

It had already been proved in ambulance service on the Mexican Border.

It had served the Allies ably in ambulance work before the United States entered the war and was selected by the Medical Department in anticipation of the United States joining the Allies. Thousands were subsequently purchased for ambulance service.

Later in the war, when the Government decided to select a truck chassis to be adopted as Class "AA" for all military purposes, this GMC Model 16, strictly on its merits, in competitive tests, in the hands of Government officials, and subjected to the most exacting trials, made a perfect score, and it became the official Government standard—picked as it stood.

Because of the enormous Government demand our production on this model had reached the point at the close of the war which now enables us, by continuing full speed ahead, to offer the trade this same model at our pre-war price of **$1,495,** a reduction of **$280.**

This is the truck that made good in France, Belgium and Italy in the days of battle; and it will continue to make good in peaceful pursuits.

This history-making Model 16 is but one of six good trucks built in the GMC factory; every one of which has equally as good a record—even though less spectacular—in more than two hundred lines of business—**prices reduced on all models.**

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SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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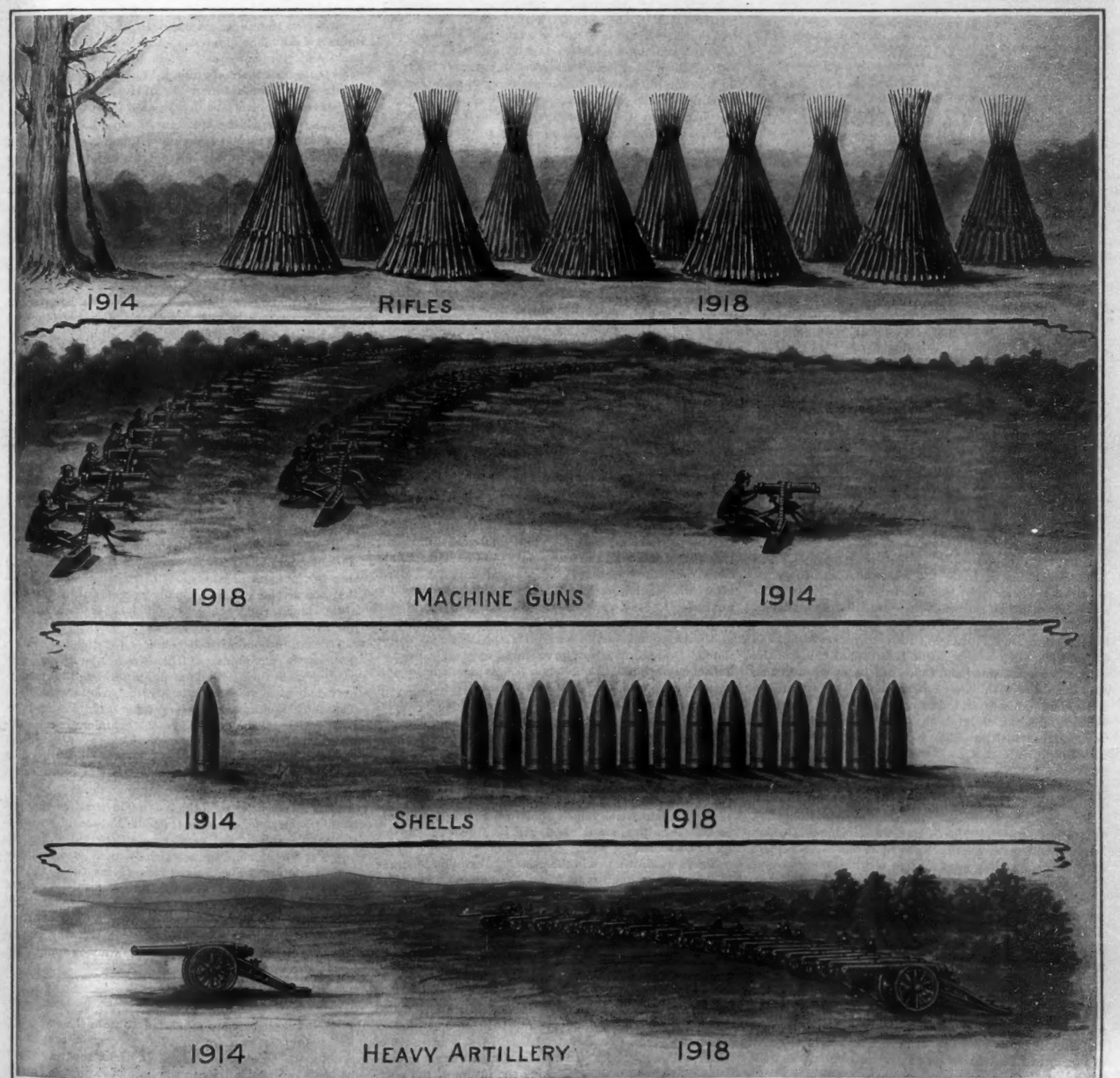

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What France's contribution toward the Allied victory has meant in terms of rifles (1 as against 290); machine guns (1 as against 70); production of shells for field artillery (1 as against 14); heavy artillery, or guns over 6-inch (1 as against 20)—[See page 138]

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The Peace Conference and the Submarine

AFTER much careful consideration of the subject, we published on December 7th an editorial entitled, "Abolish the Submarine." To those who have been familiar with the SCIENTIFIC AMERICAN it will be understood that this call for prohibiting the construction of this type of warship was consistent with our attitude to the submarine for many years past. From the very first, we believed that the fact that the submarine was both blind and sluggish and must in all probability ever remain so, would prevent it from becoming a serious weapon of war against up-to-date and well-found ships that fight upon the surface of the sea. Despite the earnest and long-continued effort to remedy these two grave and inherent defects, the submarine remains today pretty nearly as sluggish and blind as it was ten to fifteen years go. Moreover, there is no promise that these defects can be eradicated; and until the submarine, in the submerged condition (which is its fighting condition), can steam twice as fast as it can today, and unless it can see its target with practically uninterrupted vision, it must continue to be a failure as a fighting weapon.

The great day of trial—the war which was to prove the deadly efficiency of this untried weapon—has come and gone with the result that the submarine, as a weapon of legitimate war between fighting ships, is discredited. Furthermore, its sole weapon, its very *raison d'etre*, the torpedo, to carry which within point-blank range of the enemy it was designed and built, has by no means come out of this war with flying colors. Even the fast surface boats, like cruisers and destroyers, with all their advantage of speed, clear vision of the enemy, and ability to maneuver with rapidity, have failed to get results with the torpedo that measure up to the great expectations which were based upon this weapon in pre-war times. A notable instance of this was the cruiser fight in the Bight of Heligoland early in the war, when no less than sixty ships, all carrying the torpedo, fought a furious action for over half a day, in the course of which scores of torpedoes were fired, without recording a single hit. The ships that were sent to the bottom were put down by gun-fire.

So that if the Peace Conference or the League of Nations contains, as we are told it probably will, a clause setting an embargo upon the construction and use of the submarine, the science and art of naval design and construction will suffer no serious loss.

On the other hand, the peace and security of the world will make an immeasurable gain. The German navy, departing from its legitimate field, seized upon the submarine as one of its main instruments of terrorism, and carried on a campaign of piracy which, in the ages to come, will be written down and remembered as the one great German contribution to the traditions of the sea. In doing this, she incidentally and very dramatically revealed to the world the frightful menace to its security which lies hidden in this most effective weapon of piracy. Hence the growing realization of the fact, both in America and Europe, that since the submarine is of doubtful value as a weapon of war, it should be abolished altogether and the ban of civilization set upon it once and for all.

We are well aware that in times past it has been fashionable to speak of the submarine as the weapon of defense and, therefore, the ideal weapon of the small and weak nations. But we believe there is a consensus of opinion among naval men that the submarine alone can afford no adequate protection to a coastline against attack by a navy which has a powerful and well-balanced fleet of surface vessels. Admiral Rodman has given us a graphic description of the way in which his battle squadron was wont to go out into the North Sea and patrol in waters that were infested with the submarine. Not only did his American battleships pass through thirteen months of such service without being torpedoed, but the capital ships of the whole Grand Fleet we understand suffered a similar immunity.

If, as dispatches from Paris seem to indicate, the leading nations, ourselves included, are going to make a great reduction in the naval armaments, the plea for putting the ban upon the submarine becomes of particular importance. For, if a nation, taking advantage of the greatly reduced size of the world's navies, should secretly build a number of submarines far beyond its allotted quota, it might precipitate a raid upon the world's merchant fleets under conditions which would give far greater promise of success than those which confronted Germany. It was the size of the Allied fleets and their great ship-building resources which enabled them to build up a vast anti-submarine fleet in time to meet and master the sudden emergency.

And let us never forget that Germany came within an ace of accomplishing her object.

Public Interest in Automobiles

THE decided success of the double automobile show held in New York this week and last, is the very best of evidence that our motor car industries are rapidly coming back to a peace basis. Scarcely another industry was so upset by the war. Although work on motor trucks was intensified by government orders, passenger car building was virtually brought to a standstill to provide for the construction of airplanes and other war machinery.

A few months ago drastic restrictions were placed even on the use of pleasure vehicles, owing to the necessity of conserving gasoline, and quite naturally all thought of holding the customary annual automobile show in January this year was abandoned. Even after the signing of the armistice it seemed hardly advisable to revive the show. But the removal of war restrictions was attended with a remarkable reaction and with commendable enterprise the National Automobile Dealers' Association ventured to stage a belated automobile show. The response was immediate and enthusiastic. The old Madison Square Garden which a few years ago was ample enough to hold the exhibits, soon proved entirely too small for the large number of manufacturers who wished to display their products, and it was necessary to use the adjacent 69th Regiment Armory.

The wisdom of having an automobile show this year is attested by the large and enthusiastic throngs of visitors to the passenger show last week. It seems certain that the commercial vehicle show which will be drawing to a close as this is published, will be proportionately as great a success.

There was not much in the passenger exhibits that was broadly new, but in matters of detail there were many developments which showed that the progressiveness of automobile manufacturers was not halted by the restrictions of the war.

The most encouraging feature of the show, however, was the hearty endorsement given it by the general public. Motor vehicles hold an undying popular interest. A remarkable reaction from the restrictions of the war is shown in the automobile registrations which came to a total on January 1st, 1919, of 5,945,422 as against 4,941,276 on January 1st, 1918, an increase of close to twenty per cent. With such hearty public support there is little to fear for the future of the automobile industries.

Airplane and Automobile

SUGGESTIONS have been rife that the experience acquired in the building and operation of airplane engines during the war is likely materially to affect the design of automobile engines. In fact, from the delivery of the fuel by the carburetor to the delivery of power by the crankshaft, the operation of the two types of engine is identical, so one might be pardoned for supposing that a reduced size of airplane engine would at once be applicable to automobile use. That this is not at all the case, however, will be plain enough after a little closer consideration.

The airplane engine, owing to its overhead valve gear and its relatively loose fitting, is decidedly noisy—a condition which makes it undesirable for automobile use. The airplane engine, to save weight, has a light crankshaft of high-class, expensive steel. Under full power this vibrates, whereas in the automobile engine it is found advisable to employ a heavier and stiffer shaft, in order to minimize vibration. In other words, it doesn't make much difference whether an airplane engine barks and vibrates; so it is made noisy and vibrating in order to gain other advantages which do make a difference. But the automobile engine must neither bark nor shiver, and has to be built with this fact in mind.

Again, there is the question of speed. Everybody knows that an airplane engine is much faster than an automobile engine; everybody perhaps does not realize what a fundamental difference in construction this involves. Thus, carburetion in the airplane engine is such as to afford a very limited degree of flexibility, while the ground engine must mix the fuel properly for a wide range of speeds. Moreover, the airplane engine needs to develop full power at one speed only, while the driver of a car expects his engine to deliver full torque at any speed and without vibration. The shaft of the airplane engine turns at about half the speed shown by that of the automobile engine, making the two quite different as a mechanical proposition.

Nor is speed the only particular in which operation differs on land as against in the air. The airplane engine is always supplied with a light, volatile fuel allowing carburetion at elevations of 15,000 feet where the compression area is reduced 40 per cent; the automobile is supposed to handle lower grades of fuel without trouble, and in this regard must always do better in the future than in the past—for high grade gasoline gets scarcer every year. Then the airplane engine is treated like a sick baby, getting the most expert attention at frequent intervals. The automobile engine, on the other hand, is usually handled by one who is not a good mechanic, and under all kinds of treatment is expected to run smoothly for long periods without attention. In addition to this general condition, there is the specific fact that the airplane engine usually operates in a dust-free atmosphere, while the automobile is exposed to vast quantities of dust and dirt.

Without becoming too technical for the lay reader, perhaps we can point out that the airplane engine, in order to meet the demand for minimum weight, is usually provided with steel cylinders, with jackets welded on. This construction is expensive; further, it takes up more height than can be devoted to the cylinders in an automobile. Here we have another instance of sacrificing something that doesn't count—height—for something that does—weight. But the thing that didn't count in the plane does count in the automobile.

From these brief remarks it is plain that for the best results each type of engine should be considered as a separate problem, and should be so treated as best to adapt it to the conditions which it must meet. There is no advantage to be derived from trying to use the one in place of the other. Manufacture of airplane engines has helped to raise the standard of workmanship in many automobile shops, beyond question. Further than this we should hesitate to go in drawing lessons from the airplane development of the war for application to the automobile.

To Our Subscribers

OUR subscribers are requested to note the expiration date that appears on the wrapper of SCIENTIFIC AMERICAN. If they will send in their renewal orders at least two weeks prior to the date of expiration, it will aid us greatly in rendering them efficient service.

Electricity

Japanese Radio Telephone Progress.—An exchange to connect wireless and wire telephones was established in Kobe, Japan, about the first of the year by the Government Department of Communications, states *Wireless Age* in a recent issue. A wireless tower 180 feet high is now being erected in front of the largest of the Kobe telephone exchanges. Wireless telephone messages from vessels within 100 miles of the South Japan port will be connected by central operators with the telephones of subscribers in Kobe, Osake, Kyoto, and neighboring cities, thus serving the most densely populated section in Japan.

New York's Police Wireless.—Acting police commissioner of New York received on December 5th last a report of the work done by the wireless telegraph branch of the police department during the past two years. The wireless tower is on the roof of the police headquarters building, and the seagoing end of the service is aboard the police boat "Patrol," which covers the harbor and rivers which bound New York. The report shows that merchandise valued at upwards of $400,000 and some twenty-five lives have been saved mainly through information received by wireless. About 2,000 messages have been handled by the service. Headquarters has been able to receive messages from a distance of 1,500 miles, and to transmit them 300 miles.

A New Form of Variable Electric Resistance.—A recent German patent taken out by L. Strasser relates to a modification of the type of resistance in which an iron wire enclosed in hydrogen is surrounded by a heating coil. As is well known, a small change in the current flowing through the heating coil can be made to cause a very considerable change of resistance in the iron, and such resistances are claimed to have special applications for use with machines of very variable speed. The novelty embodied in the patent consists in making the heating coil of a material with a negative temperature coefficient. In this way, continues *The Electrician*, the heating coil can be caused to bring about a much greater change in the iron wire resistance, and the sensitiveness of the apparatus is accordingly increased.

Preventing Electrolysis Damage.—Various methods of preventing damage by electrolysis to gas and water systems, lead-covered cables, and other metallic subsurface structures are explained in a bulletin announced by the Bureau of Standards, Department of Commerce. Damage of this kind is caused by stray currents from street railways and is a constant source of worry and expense in the larger cities. It is said that no completely satisfactory method of preventing damage by electrolysis has been devised, but the investigations upon which the report of the Bureau is based indicate the more effective methods of dealing with the problem. The bulletin is the second edition of "Electrolysis and Its Mitigation," No. 52 of the Technological Papers of the Bureau of Standards. It is one of a series that is being issued on this subject. Copies may be purchased at 35 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Renovating Discolored Arc Lamp Globes.—At the present time, when arc lamp globes in the United States cost about $2 each, the problem of cleaning up those which have become dirty and discolored with use is worth mentioning. The magnetic arc, with which such globes are largely employed, is apt to give off a metal fluff which gradually accumulates in the interior of the globe. This deposit can be cleaned off without much trouble with a little muriatic acid. A more serious matter is the discoloration which commonly takes place in globes containing traces of manganese, under the action of light. This discoloration is not merely superficial, but extends into the interior of the glass and cannot, therefore, be removed by scouring. Mr. A. Herz, in an article in the *Electrical World*, describes a process of baking such globes at a suitable temperature in ovens whereby, it is stated, the discoloration is completely removed in the course of about 24 hours. As the entire process, including removal of deposits, cost of gas or electricity for heating the oven and labor, only costs about 35 cents per globe it is considered well worth while using. Globes so treated will retain their transparency sufficiently for about 75 per cent of the time during which a new globe can be used before renewal. It may be recalled that the fact of this discoloration being removed by heat was referred to by Mr. Luckiesh last year.

Astronomy

A Helium Star with Large Parallax.—Stars of the helium type (Type B of the Harvard system), are usually characterized by small parallax, small proper motion and low radial velocity. A notable exception has been found by J. Voûte, observing in South Africa, in the case of the star Boss P. G. C. 1517, in Columba, for which his photographic measurements give a parallax of +0.069 sec. ±0.006. He also gets for this star the relatively large proper motion of +0.235 sec., while R. E. Wilson, of the D. O. Mills observatory, has determined its radial velocity to be 83 kilometers per second.

Measurements of Southern Double Stars.—A notable collection of double star measurements, by Bernhard H. Dawson, has recently been published by the observatory of La Plata, the only observatory in the southern hemisphere, with the exception of that at Johannesburg, regularly engaged in measurements of this kind. Mr. Dawson's measurements extend from S. decl. 42 degrees southward, and eventually the work will be extended to the south pole. The stars were selected mainly from the list of Sir John Herschel's discoveries at the Cape of Good Hope. The number of Herschel pairs remeasured in this undertaking was 985, and the total number of pairs measured, 1,305.

Astronomy in British Schools.—A committee appointed by the British Astronomical Association to consider plans for furthering the teaching of the elementary facts of astronomy in schools has made a report recommending, among other things, that the Association appoint a standing committee on this subject. Its functions will be to give aid and advice to teachers in regard to astronomy, to draw up suggested courses of instruction, to provide lectures for schools, and to keep track generally of the interests of the science in the British educational system. The astronomer royal, Sir Frank Dyson, made the elementary teaching of astronomy the subject of his presidential address at the last annual meeting of the Association. From this address it appears that the public of Great Britain is quite as deficient in astronomical knowledge as our own. He stated that in showing visitors over the Royal Observatory he had frequently pointed out a photograph of the Orion nebula and asked them whether they knew the constellation of Orion. The answer was generally in the negative! The speaker expressed the opinion, which we believe is true in America as well as Great Britain, that "in spite of the spread of general education, the knowledge of the elementary facts of astronomy is less widely diffused than it used to be." The use of "the globes," a regular feature of the old-fashioned curriculum, seems to have passed out. Terrestrial and celestial globes, a simple orrery and a small telescope should be included in the equipment of every school.

The Death of Prof. Edward C. Pickering deprives America of one who probably ranked as her foremost astronomer, and takes from Harvard the second in seniority among her active professors. During his 42 years of service in Cambridge the Harvard Observatory has quadrupled its capital and income, and increased in far greater ratio its influence in organized astronomy. It was largely through Professor Pickering's initiative that the system was built up whereby Harvard kept in correspondence with observatories and private astronomers all over the world, to the great benefit of all in the resultant opportunity for comparing and verifying observations and computations. In addition to this, he was always a leader in astronomical photography and in the study of stellar light and stellar spectra. Some idea of the scope of his work in these directions is to be had from the statement that during his period of superintendency the Harvard Observatory has effected nearly a million and a half direct measurements of the light of stars. Part of this work has consisted in a painstaking following of all known variables of sufficient range to make their study worth while; so that the Harvard collection of data and photographs is the standard to which all questions bearing upon this important class of stars are referred. The influence of Professor Pickering's guiding hand will be the less missed in that he leaves a competent organization behind him but his loss is one that American astronomy will long feel. He possessed in the last degree that combination of scientific and administrative ability which is as rare as it is valuable.

Industrial Efficiency

Additions to Department of Commerce.—Two of the important organizations in the War Industries Board are, by direction of the President, to be turned over to the Department of Commerce. These are the Resources and Conversion Section, the activities of which will be continued only temporarily, and the Conservation Division, which will be incorporated permanently in the Department of Commerce. The Conservation Division of the War Industries Board was at first known as the Commercial Economy Board, and its function has been "the studious conservation of resources and facilities by scientific, commercial, and industrial economies." The material gathered and the staff developed will enable the Department of Commerce to carry on the work of eliminating waste and promoting precision in business which it has long had in mind.

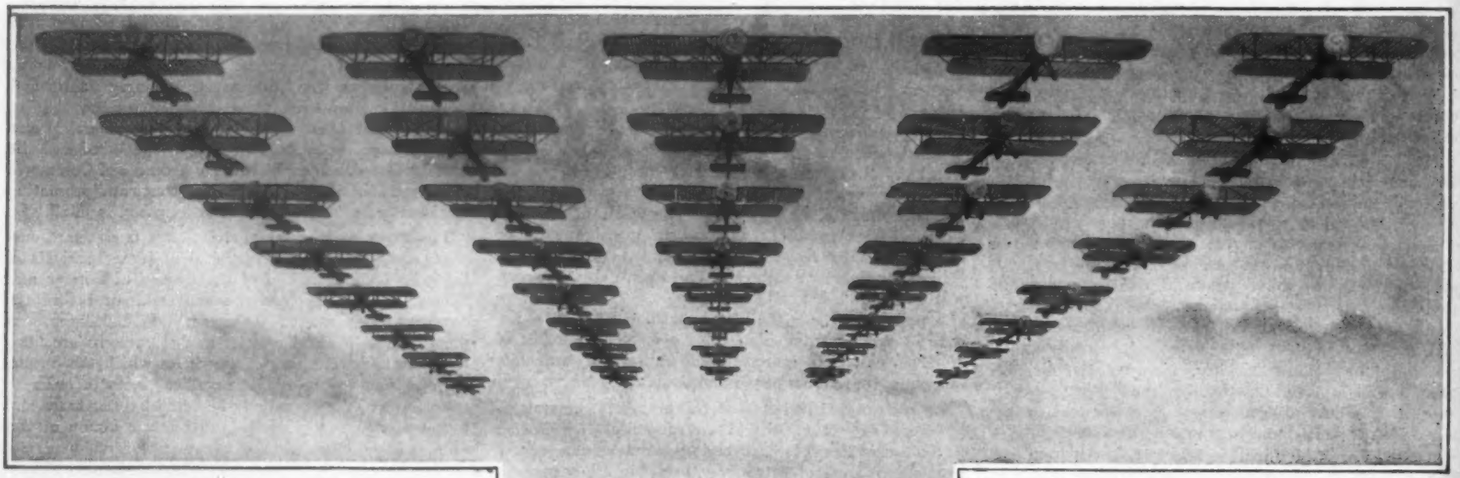
The Price of Raw Materials.—We must guard ourselves against motives of fear in the business world, states Burwell S. Cutler, Chief of the Bureau of Foreign and Domestic Commerce, in a recent address before the Southern Commercial Congress at Baltimore. At present most of our factories and storerooms are filled with raw materials and commodities which the owners may be tempted to sell at sacrifice prices in order to restore cash balances wholly depleted by war taxes and purchase of Liberty Bonds. Precipitate action of this kind, if based on a fear that raw materials will generally decline in value, will bring individual and national loss. The most knowing and deliberate business men realize that the available supply of basic materials for human use and consumption is many times less than the world will need for some years to come. This is the inevitable result of four years of systematic destruction without replenishment in every quarter of the globe.

Danger in Next Four Months.—"The great danger in the coming four months is that there won't be jobs enough to go around; that unemployment will come with attendant misery and social unrest at a time when anarchistic tendencies are contagious. Let us hope that this situation will not arise, but let us guard against it," stated Mr. Smyth at the recent Labor Reconstruction Conference. "The remedy of building public works is not available on large scale until spring," he continued. "The farms will not call urgently for men till frost thaws out. Building can not for a season be resumed to any great extent. Chiefly must we look to our manufacturers to carry the burden. But they are hesitant. Taxes are not yet determined. The cost of money is high and credit timid for a while. The prices of raw material and labor are high. The producer hopes that they will fall and manifests a tendency to wait till they do. To meet each of these deterrent features is an immediate national task."

Careless America.—According to statistics compiled by the Police Department of the City of New York, approximately 25,000 persons were injured by automobiles and motor trucks in the streets of Greater New York during 1917. Other cities, as well, have large lists of automobile accidents in proportion to their populations. The strict enforcement of traffic codes and police supervision of the use of streets and highways have, undoubtedly, tended to keep down the toll of traffic accidents considerably in some sections, but it is plainly apparent that public officials can accomplish but little in accident prevention without intelligent coöperation on the part of the general public; and this is largely a matter of educating individuals, who comprise the general public, to a keener sense of their responsibilities in the matter. In an attempt to direct public attention to the enormous loss of life and efficiency due to automobile accidents in the United States, Mr. H. S. Firestone, president of a large tire company, has enlisted the services of a leading film company to produce an educational film entitled "Careless America." Various types of automobile accidents are vividly presented on the screen, and shown to be due to the carelessness alike of drivers and pedestrians. The scenes are most realistic and thrilling. No less than nine automobiles are said to have been destroyed in producing the sensational scenes of accidents due to recklessness. Through the courtesy of Mr. Firestone, this film is now being shown, without charge, in villages, towns and cities throughout the United States, as an added feature of the regular programs of motion-picture theatres and local entertainments.

France's Rôle in the World War

What Our Sister Republic Paid in Life and Treasure Toward the Victory of the Allies, as Told by the Official Figures



FRANCE, of all the Allies, was the only one ready to fight the German masses in the early part of the war. This was due to her geographical location and also to historical circumstances. The close proximity of the threatening German Empire, and the recollection of the preceding war of 1870-71 had made her prepare her armies to defend French soil against a German onslaught, which was constantly expected.

Therefore France's rôle in the common action was to gain time while her allies organized and trained their armies; the French soldier stood firm while waiting first for the divisions of the British Empire, and then for those of the United States. The victory could not have been won had France been unable to hold the line while Lord Kitchener, and later General Pershing, were getting their troops in line.

As time was working for the Allies, those virtues which were commonly said to be characteristically French, dash and galantry, were no longer sufficient. In such a war patience, perseverence, and unity were required by the French people, who have often been misrepresented and believed incapable of sustained effort. But since August, 1914, facts have indeed spoken for themselves.

Everybody knows how formidable was the flood of men and artillery pouring through Belgium and Northern France after the unsuccessful attack of the French in Alsace, during August, 1914. The mass hurled against the French consisted of about 1,500,000 men with 4,000 field guns, 450 batteries of heavy guns, and 700 enormous mortars. This mass was stopped between Paris and Verdun, in the region of the Marne, from the 6th to the 12th of September, 1914, by the French armies of General Joffre with the help of the seven gallant divisions of Field Marshal French. Then, after the "rush to the sea" in the effort of each side to outflank the other, the new drive of the German army toward Ypres and Calais, from the 23d of October to the 11th of November, was stopped by the divisions of General Sir Douglas Haig, reinforced by the French army corps brought up by General Foch.

Then began the long watch from the North Sea to Switzerland, while Lord Kitchener was silently preparing his armies of volunteers. Attacks were delivered on the 9th of May, near Arras, and on the 25th of September, 1915, near Arras and in Champagne, by French and British troops, in order to help Russia who was fighting desperately against German onslaughts. When the Crown Prince attempted to destroy the French at Verdun from February to July, 1916, before the British armies could come into line in large numbers, he met with a victorious resistance, which, as Lloyd George has said, will ever be imperishable. Verdun saved not only France, but the great cause of all the Allies. Because of the battle of Verdun, the drive on the Somme during the second part of 1916 was possible, the new armies of Kitchener, with supporting French troops, almost compelling the German army to effect a general withdrawal.

In 1917 while successes were being won in the various attacks delivered by the French—the Aisne, April 16th and May 5th; Verdun, August 24th; the Aisne, October 23d, and in Flanders—the British were gloriously attacking in many drives between St. Quentin and Ypres.

At last, in 1918, the French aided the British in repelling the big German offensive of March 21st. The order was "Stand firm; the Yanks are coming." A French commander—Foch—was made generalissimo of all the Allied armies. No one in France lost hope in the ultimate fate of the Republic and her armies, although those days were of the blackest, with the Germans advancing over wide expanses of French soil. Likewise on the 27th of May, Paris was saved by the desperate resistance of the French, aided by the heroic troops of Haig and Pershing. Every fighter knew that more and more American divisions were landing and that victory would belong to the army that could hold out the last 15 minutes. After the failure of the German drive of July 15th, French and Americans began the victorious rush forward which was to result in the common victory of the Allies and the armistice of November 11th.

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In 1918 the French Army had 40 airplanes to each one in 1914

That was France's share on the Western front. The richest, most thickly populated section of her country was sacrificed as a battlefield for the struggle between the forces of evil and the forces of right. Every time the Germans advanced even a foot, that much more of the soil of France was invaded, ruined, despoiled. Every time a mine was blown; every time a shell, whether from German or Allied cannon, detonated, that much more damage was committed on French property. And hundreds of thousands of French citizens were brought into direct contact and suffering with the forces of militarism and those of outraged civilization.

Besides all this, France maintained an army of 200,000 men in Salonica, after having given her coöperation to the British at Gallipoli. The French navy had already effected the evacuation of the Serbian army of 120,000 without loss from Albania to Corfu, where they were re-equipped and restored to fighting form. The navy defended the transport service for troops and their supplies to Salonica, against hostile submarines. The great attack in Macedonia under the French General Franchet d' Esperey, led by French and Serbian troops supported by British and Greek troops, broke up the Bulgarian armies and caused their unconditional surrender in a few days' time.

Some figures will show the military effort of France: 7,700,000 men have been called to the service since August, 1914. Approximately 1,400,000 have been killed, and 1,000,000 are disabled or missing. In spite of these losses France was not exhausted, for she was able to maintain an army of 113 divisions on the Western front until the last days of fighting. At the time of the signing of the armistice, there were still close to 3,000,000 Frenchmen in the advanced zone of the French front.

From another official source the number of men mobilized by France from the outbreak of the war is given as follows:

August 15th, 1914.—Officers, 92,828; soldiers, 3,780,000. February 15th, 1915.—Officers, 97,753; soldiers, 4,900,000. January 1st, 1916.—Officers, 109,814; soldiers, 5,069,000. January 1st, 1917.—Officers, 115,004; soldiers, 5,026,000. January 1st, 1918.—Officers, 128,372; soldiers, 5,064,000. On January 1st, 1918, the infantry numbered 2,106,775; artillery, 899,645; aviation, 59,285; cavalry, 166,422; engineering corps, 185,110.

Behind the firing line, during the long war, factories were required to manufacture shells, guns, machine guns, and equipment and supplies of all kinds. In August, 1914, France had lost first, the region of Briey, rich in iron; secondly, the coal mines and the iron works of the northern departments. "Out of 127 blast furnaces," said a prominent German metallurgist, "only 30 may produce pig iron in France."

In spite of these serious handicaps—in spite of the lack of coal and iron, France was able to manufacture every war material. In October, 1918, French plants were turning out 180,000 75 mm. shells per day, instead of 13,000 in August, 1914; 45,000 of the 155 mm. shells, instead of 200; 60 guns of all calibers were being produced per day; 150 to 160 light or "baby" tanks per month, and 7,000 aviation engines every 30 days.

For every 100 rifles which France had at the beginning of the war, she had 29,000 at the termination of hostilities. For every 100 machine guns, she had 7,000. Aside from meeting her own requirements, France furnished 1,350,000 rifles, 15,000 automatic rifles, 10,000 machine guns and 800,000,000 rounds of rifle ammunition to various Allies. The American Army was equipped with French cannon until American artillery began to flow across the ocean during the closing days of the war. France had to create a heavy artillery: from the 300 heavy pieces at the beginning of the war, she built up a heavy artillery strength of 6,000 guns, while sending large numbers of heavy guns, particularly 155 mm., to Russia, Roumania and Serbia, and to the Americans in France. At the close of hostilities France possessed 17,000 cannon, and 6,000 trench mortars and small 37 mm. cannon used by the infantry.

In aviation, France has built up a vast air fleet. Starting with 100 airplanes in the French army of 1914, the closing days of the war witnessed a French air force of 4,000 machines of the latest types. The pursuit types developed by the French, particularly the Nieuport and the Spad, have been used by all the Allied armies. Aside from meeting her own demands, France supplied airplanes of various kinds to her Allies, including America.

The industrial effort of the Republic could not have been sustained without a corresponding financial effort. Notwithstanding the loss of the regions of the North, which paid 25 per cent of the total amount of French taxes, the citizens of France were in 1918 paying to the State $50 per inhabitant, or $1,651,371,146 while they yearly paid before the war, $765,779,816. The total war taxes have given to the State since August, 1914, $4,464,220,182.

The three war loans (1915, 1916 and 1917) realized $5,882,955,780, and the fourth loan of November, 1918,

is still too recent at this writing to know what it has netted. Through short term treasury bills there was obtained $4,973,333,027. Foreign countries loaned to France $4,711,736,880—England, $2,303,289,358, and United States, $2,181,121,835. The Banks of France and Algeria advanced $3,562,385,321.

Thus there was raised, in all, $23,599,611,190 during the course of the war, which met all the expenses of France of which the total amounts to $23,486,238,552.

In that war which withdrew from the national life all the best men, the activity of the women was one of the most wonderful things France has shown to the world. The French women, prepared by the powerful feminine organizations which existed before the war, were prepared and were anxious to play their part in the struggle.

For educational purposes, thousands of young women took the place of the schoolmasters or of high school professors, 12,600 women taking the places of 30,000 men. In the railroad administration more than 15,000 women took the places of the missing men. In banks and other commercial houses, large numbers of women took over the work. In metropolitan transportation, the women were extensively employed. In the army services and various administrative bureaus, 150,000 women took the places of men.

French women have been members of town councils. Some of them—for instance, Mme. Macherez, "Mayor of Soissons"—have struck the Germans with amazement by their firmness and audacity. Others, such as the young school mistresses, become mayor's secretaries and ruled, to the great wonder of the failing town councils, vast townships with the same genius as they would their own home. The French Red Cross is entirely organized and managed by women. In 1914 there were 250,000 members with a capital of $6,000,000 for 600 hospitals.

Thanks to the efforts of the Secretary for Armament and the Assistant for Ammunitions, women were employed in all the war industries. To protect them against all risks, to secure them good wages and good health, a Committee of the Work of Women was created, whose efforts have brought in the war industries more than 500,000 women.

For every two women working before the war, there were in January, 1918, 781 in iron works, 148 in chemical works, 630 in the transportation business, 161 in woodworking industries, 111 in the leather industry, 104 in rubber, paper and pasteboard factories, and 102 in various other trades. Altogether in agriculture, various administration bureaus, war industries and so on, more than 1,500,000 women were engaged in war work. Theirs has been a great contribution indeed toward Allied victory.

And it must be borne in mind, when thinking of these figures, that France is not as big as the United States, Great Britain, Austria or Germany in point of population. Her population before the war was between 39 and 40 millions, exclusive of her colonies. But the Republic went to war heart and soul. She put the very best she possessed into the great cause, regardless of cost.

And with the victory won, France is ready to resume her proper place among the leading nations of the world, with full assurance of a durable peace.

Landing the Airplane on a Roof

TO be really practical in everyday life, the airplane must be capable of landing on housetops in crowded metropolitan districts where there is no land available for a flying field. Otherwise it would profit an aerial commuter but little to make a flight of say 25 to 50 miles every day from his home in the country to his place of business, only to have to land at a flying field somewhere outside the city and then have to travel a half hour or more to reach his office.

It has remained for Jules Vedrines, the famous French airman, to demonstrate that even the present-day airplane can land on a roof if properly handled. On January 19th last, Vedrines set out from the aviation field at Issy les Moulineaux, notwithstanding a thick fog, and flew toward Paris. He flew rather low over the boulevards in order to get his bearings. On approaching the Galleries Lafayette, a large department store near the St. Lazare Station, Vedrines shut off his engine and volplaned toward the roof. Skimming the parapet by a few inches, he made a spectacular landing, although the machine was slightly damaged.

The roof on which Vedrines landed is 52 feet wide and 75 feet long. The machine employed was a Caudron tractor biplane, equipped with a rotary engine. Its span was 36 feet, leaving little room to spare on the narrow roof.

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Vedrines' Caudron after alighting on the roof of a Paris department store

Vedrines won a prize of 25,000 francs ($5,000) for being the first airman to land upon the roof of a house during a flight.

The Sighting Problems of the Aviator

ONE of the greatest difficulties experienced by aerial fighters, when machine guns on airplanes came into general use, was to hit the target aimed at. This may seem, to the uninitiated, like a bald statement of poor marksmanship, but in reality it is not. As a matter of fact to bring down an enemy machine without specially designed sights is nothing more nor less than pure, unadulterated luck.

For instance, imagine two machines passing each other along parallel lines, 100 yards apart, each traveling 100 miles per hour. You are equipped with a machine gun firing 700 shots a minute—11 each second—the bullet traveling at the rate of 4,960 feet per second. If you took a dead aim at the enemy machine your first bullet would miss its mark by 18 feet, and the second bullet, coming $\frac{1}{11}$ of a second behind the first one, would miss its mark by 45 feet.

To offset this, and to make aerial fighting more of a science, ring sights were devised. These sights consist of two rings, a small one, representing the bull's eye, and a larger one encircling it, representing the line of flight of the bullet. If aim is taken when the enemy machine is crossing the outer circle (the hostile aircraft being 100 yards distant and traveling at the rate of 100 miles per hour) the bullet would reach it as it enters the smaller ring, constituting a direct hit.

But this only compensates for the speed of the enemy machine. You still have to make allowance for the speed of your own machine. This is done by means of the Norman Compensating Foresight, a bead sight fitted to a swivel, with a wind-vane swinging on one side, which raises and lowers the bead, and revolves on its axis, according to the pressure of the wind in the slip-stream.

The most wonderful of all sights, however, is the Aldis Optical Sight, used for stationary guns when firing through the blades of the propeller. This sight was invented by the two Aldis Brothers, manufacturers of lenses, who, under subsidies from the British Government, have brought the making of high grade lenses to a higher point than the German's finest workmanship.

The Aldis sight is virtually a telescope which neither magnifies nor diminishes, and which, unlike an ordinary telescope, can be used with the eye several inches from the end of the tube.

When looking through this tube at a distant object the effect is exactly as though one were looking through a napkin ring—the object appears the same whether it is seen through the tube or outside it—but, apparently suspended in the air, is a ring sight. The peculiarity is that the ring is seen with its center on the spot at which the tube is pointing, no matter where the eye is placed. If the eye is moved sideways the ring appears to move with it through the telescope, so that the direction in which the tube points is always toward the center of the ring.

The tube, when fixed rigidly to a gun, thus constitutes a sight which offers practically no obstruction to the view, and which shows instantly the spot at which the gun is pointing, without the necessity of alining the eye on a front and back sight. The effect produced on the pilot of seeing an enemy machine flying into this ring suspended in mid-air is quite startling.

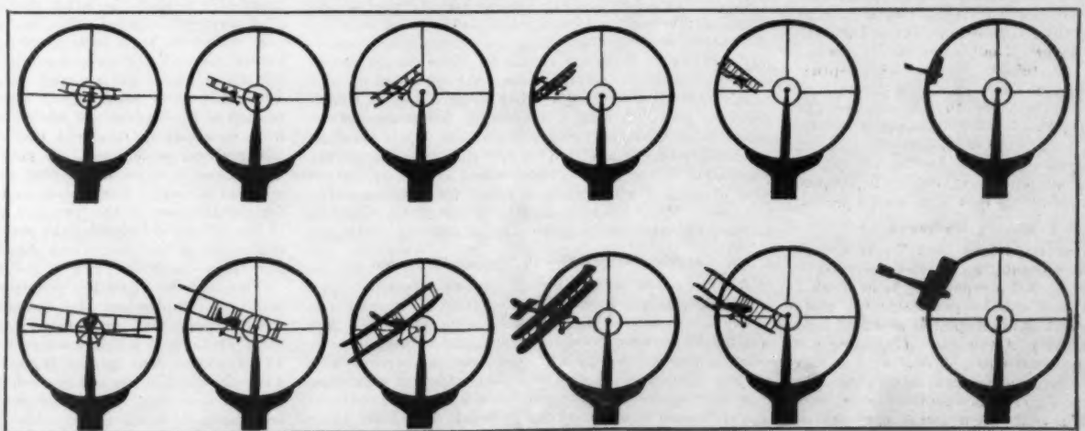
One advantage of this sight is that it can be used with both eyes open. One eye sees the object and the circle through the tube, the other eye sees the object direct. The effect, after a little practice, is that the object is seen as clearly as though there were no sight at all.

The tube is about three feet long and about three inches in diameter, and contains five specially constructed and arranged lenses.

One fact about aerial fighting, however, which has never been mentioned is that, after the first sight has been obtained, the pilot never uses his sight at all. He watches the bullets—literally! That is, he watches the tracer ammunition. One in every three shots is a tracer—a bullet which trails a little path of smoke; and it is much more interesting to watch the tracers than it is to keep the eye on the sights. Most pilots would like to use *all* tracers if they could, for they kill as readily as the regular bullets. But, unfortunately, tracer ammunition is dirty, and will soon choke the bore of the gun. As it is, a great many pilots load their magazines and belts with every other one a tracer, though it is strictly against the rules. The temptation though is too great to be resisted.

The tracer is made the same as the ordinary bullet, except that, in the end, is a small quantity of magnesium which ignites. It is not quite accurate, as it is lighter and drops a little in its flight, but it serves its purpose wonderfully.

There is a fortune waiting for the man who can devise a tracer that will not foul the bore, and which will accordingly permit the aviator, or indeed any machine-gunner operating at short range, to employ it exclusively.



Silhouettes illustrating the use of the ring back-sight with the wind-vane fore-sight

(The former is set for the estimated speed of the adversary, while the latter automatically compensates for the speed of the plane on which it is mounted. The upper row of silhouettes is for a range of 200 yards; the lower row shows the same objects at 100 yards.)

British National Restaurants

IN a statement given out to the press recently, Mr. Spencer, director of national kitchens and restaurants of the Ministry of Food in Great Britain, said that the new National Restaurant is now making a profit of $500 a week. In view of its success additional restaurants are being set up in London and in the Provinces.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Some Non-Poisonous Gases and Their Uses

IT seems to be the way of the world that the black sheep of the family shall receive the most publicity and this applies to materials as much as to people. In any event, the average man is prepared to discuss poisonous gases as used in warfare, even if he does indulge in the error made by the lady who wished the ex-kaiser might be "compelled to sleep on a straw mattress sprinkled with the mustard from which mustard gas is made!" Ask him about other gases and he is apt to lapse into silence or to become the inquisitor, while if the kind of gas which cooks his meals is mentioned as one of those which helped to win the war, a look of incredulity may spread over his face. We, therefore, propose to call attention to a few non-poisonous gases and to industrial gases, if indeed, not industrious ones.

Quelling Mobs with "Tear" Gas

As has been said previously, one and possibly two of the war-developed gases deserve to be kept as offensive weapons of the law, while substances which produce dense volumes of harmless smoke have, no doubt, come to stay. They are altogether too useful as screens for operations in the field to be discarded, and form an excellent method of defense. The gases to which reference is made, are the lachrymators and the sneeze provoking gases. Highly efficient gases of each sort which leave no harmful effects are now available for use against mobs and will be more effective than any other method for breaking them up and giving the individuals something to divert their attention. They will reach where water, so often used, cannot penetrate and the effect is for a longer time. It will be recalled that in the Philippine campaign the Americans were required to fight the fanatical Moro who welcomed death and conducted a difficult kind of warfare. There was an instance, so we have been informed, where the warriors used as a shield their women and possibly children and occupied a position such that our troops must kill or be killed. The result gave rise to considerable criticism of our troops and it seems probable that a few gas shells would have made the story quite different. Continual sneezing and the eyes blinded with harmless tears for a few hours ought to give any fanatic a change and direct his few thoughts into different channels.

T. N. T. from Illuminating Gas

Illuminating gas has been able to play a war part because of the oil used to carburize water gas in order to increase its candle power. In many states the heating value or "B. T. U." (British Thermal Units) of the gas is the standard, since the greatest volume of the gas is burned for heating purposes or in mantle burners where the temperature of the mantle and not the candle-power of the gas determines the illumination. Investigation showed that some 2 per cent of the oil added could be recovered as toluol which is the starting point for "T. N. T." and the government experts designed apparatus to scrub out this precious hydrocarbon. A number of stripping plants were installed with government funds and operated in the main under government supervision. The scrubber is a tower with many wooden grids over which partly refined petroleum trickles counter-current to the gas, absorbing the hydrocarbons formed by the cracking of the petroleum. Distillation under correct conditions separates out toluol, benzol and naptha. The oil may be returned to the towers, the benzol and naptha used as such or returned to the gas, and the toluol started on its way to a terrible explosive in war or, in certain quantities, to a series of important, pleasing shades of synthetic dyes in peace. In the vicinity of New York alone, the equivalent of nearly 28,000,000 pounds T. N. T. was recovered in a nine-month period.

Methods of Producing Hydrogen

Balloons played their important part "over there" and a balloon is useless without gas. Such a gas must be lighter than air, of course, but one gas may be somewhat heavier than another and still be preferable for other reasons since the amount of air displaced is a factor as well as the specific gravity of the gas. Hydrogen has always been the balloon gas and yet it is very highly inflammable and even explosive when mixed with the right proportion of air. The comparative ease with which it may be made is in its favor and it is, of course, much cheaper than any other suitable gas. There are many ways of making hydrogen, some yielding a purer gas than others. A favorite way is to pass steam over spongy iron at a temperature of 900° to 1,000° C. whereupon the iron takes up the oxygen present to form iron oxide leaving hydrogen of reasonable purity. When the temperature falls, hot producer gas is turned in and burned with air in the chamber, during which operation the carbon monoxide of the producer gas reduces the iron oxide to spongy metallic iron again and is itself oxidized to carbon dioxide. A system of regenerators is employed to conserve the heat and properly designed furnaces last for months. They are usually constructed to allow those parts subjected to the greatest wear to be replaced without rebuilding the entire furnace. By purifying the reducing gases the efficiency of the iron mass can be maintained for many months. The process requires careful temperature control.

Portable Compounds Which Yield Hydrogen

Much work has been done on special compounds which may be transported and easily caused to give up hydrogen in the field. Hydrolith, for example, will yield one cubic meter per kilo and with rapidity. It is 90 per cent pure calcium hydride and is prepared in the electric furnace by passing hydrogen over calcium in an iron tube. It is, however, an expensive method.

Hydrogenite will give up 320 liters per kilo. It is 5 parts ferro-silicon containing 90 to 95 per cent silicon, 12 parts sodium hydroxide and 4 parts slacked lime. The reaction is started by dropping in a hot iron slug. The action of acid on metal such as sulfuric acid on iron, zinc or magnesium has been used, but this is no longer employed because of the mountain of raw material needed, a small airship of 500,000 cubic feet capacity requiring the reaction of about 60 tons of acid with 36 tons of iron to fill it with hydrogen. The latest dirigible is of nearly 3,000,000 cubic feet capacity and we already read of one of 10,000,000 cubic feet being designed! More recently electrolytic hydrogen has come into prominence especially for the arts of peace. A weak acid or alkali solution is subjected to electrolysis in a special cell made up of a number of frames through which it circulates and each frame is provided with a diaphragm, sometimes of asbestos with rubberized edges to prevent loss of solution by capillarity. These diaphragms facilitate the proper separation of the gases formed which otherwise, in the case of oxygen and hydrogen, might form an explosive mixture. Much may be said in favor of this method because of its relative simplicity and the purity of the gas.

Some of the Interesting Characteristics of a Few Gases

GAS	Formula	Specific Gravity Air = 1	Boiling Point °C. atmospheric pressure	Critical temperature °C.	Critical pressure in atmospheres except as noted
Acetylene	C_2H_2	0.9056	—83.6	36.4	61.6
Air		1.0000	—191.4	—140.	39.
Ammonia	NH_3	0.5971	38.5	132.3	109.6
Argon	A	1.379	—186.1	—117.4	52.9
Carbon Dioxide	CO_2	1.52908	—78.2	31.	72.85
Carbon Monoxide	CO	0.96716	—192.0	137.7	34.6
Chlorine	Cl_2	2.4901	—33.6	146.	93.5
Cyanogen	C_2N_2	1.8064	—22.	124.	61.7
Helium	He	0.131	—268.75	—267.75	1718 mm.
Hydrogen	H_2	0.06952	—252.5	—240.8	13.4
Nitrogen	N_2	0.96737	—195.5	—146.	25.
Oxygen	O_2	1.1053	—182.7	—118.0	49.3
Sulphur Dioxide	SO_2	2.2638	—10.0	157.2	78.0

Taken from van Nostrand's Chemical Annual.

The critical temperature is the temperature below which a gas can be condensed to a liquid and above which it undergoes compression without liquefaction.

The critical pressure is that which at the critical temperature is just enough to condense the gas to a liquid. When the temperature is lower than the critical temperature, less pressure than that indicated will cause the gas to liquefy.

Cracking Natural Gas to Produce Hydrogen

A novel source of hydrogen is natural gas which may be cracked to produce the hydrogen from the methane present. If a checker-work of brick is heated hot enough by burning gas and air in it, the air may be shut off and the hot bricks will effect the conversion with carbon black as a byproduct. The gas after scrubbing may be compressed in the usual manner. Where natural gas is lacking petroleum may be cracked with the same results by spraying the raw material into a properly heated chamber. The temperature of operation has a direct effect on the yield and purity of the gas.

Hydrogen is sometimes produced from water gas by the liquefaction of the carbon monoxide. By using this carbon monoxide for fuel, enough power is produced to operate the plant, the labor charge is relatively small, and at Ferrari, Italy, where the Linde-Frank-Caro process is operated, hydrogen of 97 per cent to 98 per cent purity is made at a cost of about 2.5 times the cost of water gas per thousand cubic feet. Two volumes of water gas are required to give one of hydrogen and any carbon dioxide is removed by scrubbing with water under pressure. As an added precaution a solution of sodium hydroxide may be used to take out the last of the carbon dioxide.

Cutting Metals with the Oxy-Hydrogen Torch

The important uses of hydrogen besides aeronautics are in combustion such as the oxy-hydrogen flame and the lime light, in synthetic ammonia, as an inert atmosphere and in oil hydrogenation. That used in aeronautics must be free from arsenic and phosphorus, which might form compounds deterimental to the balloon fabric, while each 1,000 cubic feet should lift a minimum of 68.5 pounds. A practical balloonist will judge the quality of the hydrogen by the way in which a given balloon will lift its burden. The oxy-hydrogen flame attains 2,800° C., which is hot enough to cause lime or magnesia to become incandescent and finds its most useful application in welding, fusing and cutting metals. One important series of machines depends upon this method of cutting heavy circles of steel from special sheets to form the gears. The cutting is done rapidly, precisely and smoothly by the flame carried on a rotating arm and if this cutting could not be done so economically the machine design would have to be fundamentally changed.

Synthetic ammonia will be discussed another time. Hydrogenation is one of the blessings which one pro-German writer claimed for the military party, holding that without cheap hydrogen required for Zeppelins no progress could have been made in changing oleic acid, $C_{18}H_{34}O_2$ into stearic acid, $C_{18}H_{36}O_2$, by the addition of hydrogen, H_2, in the presence of a catalyst. The history of hydrogenation hardly sustains the argument. The process has become one of much economic importance and is just starting.

Helium from Natural Gas

More recently it has been found that some natural gas contains a rare gas, helium, in much larger percentage than does air or any other source and this gas possesses the distinct advantage, for balloons, of being non-inflammable. The various properties have been known for some time, but the large amounts of air which had to be cooled and compressed to the point at which nitrogen is liquefied and where helium is still gaseous, made its cost about $2,400 a cubic foot. This would be far out of the question even in a military program but when natural gas, containing as high as 4 per cent helium, was found in one of our oil fields it was decided to attempt its recovery on a commercial scale with $0.02 per cubic foot as the goal! A Frenchman has said that the only difference between the difficult and the impossible is that the latter requires longer for accomplishment, but in what other line of endeavor has such a cost reduction been attempted? There were two well known methods for air and gas liquefaction and a third, for which much was claimed, was awaiting a try-out. Ultimately three small plants were built, one according to each of these plans and while the new method has not been conclusively tried out the indications are that it will perform as claimed. It greatly reduces costs, requiring as it does much less power. It is doubtful whether it would have been so thoroughly tested but for the impetus of the war and indeed the quickening of many lines of industry, the proving of ideas, the demonstration of new inventions ahead of their normal turn and time—these are some of the war's benefits.

Thus far the $0.02 has not been realized, but about $0.08 has; and when the armistice was signed some 150,000 cubic feet were ready for shipment. Imagine the sensations of a man used to working with helium at $2,400 a cubic foot upon seeing cylinders holding 150,000 cubic feet! The natural gas relieved of its helium was allowed to evaporate into the mains and was none the less desirable for heating. And it had been scrubbed for gasoline before the helium was recovered! Air is reckoned as 1. in the specific gravity column, hydrogen

(Continued on page 154)

British Ideals of Reconstruction

"Rebuilding the National Life on a Better and More Enduring Foundation"

By C. H. Claudy, Special Foreign Correspondent of the SCIENTIFIC AMERICAN

WITH a reconstruction problem of infinitely greater magnitude than that which confronts the United States, it was only to be expected that Great Britain would be devoting much serious thought and attention to it, long before we of America did more than recognize that we might come face to face with such a problem of our own, after the war. There is nothing surprising in England's Ministry of Reconstruction, in her careful plans, in her able working out of a general scheme and the painstaking attention which has been bestowed upon its details. But to find not only an accurate, scientific, exact grasp of the problem in its practical aspects, but also an *ideal* of reconstruction may be as surprising to those who read this as it was to him who writes it.

If the average American business man were asked to sum up in a few words his conception of the national characteristics of the average Britisher, leaving out all considerations of national pride, he would in all probability give equal weight to bull-dog courage, high tenacity of purpose, inflexibility of will, and a conservatism of viewpoint largely influenced by ancient tradition. Indeed, more British people will admit the latter than boast of the former. When, therefore, one finds the people of this nation widely wideawake to the fact that the war has presented them with their most tremendous opportunity for a real reconstruction of those features of industrial and national life which have been, at least from the American standpoint, most restrictive of her trade and industrial expansion, one is brought very sharply to the realization that the effect of the war is by no means confined to material but spreads to mental and political life.

Were this new spirit sporadic and not general it would deserve little attention. But it is national, and it is *governmental*. For instance, from government publications the following excerpts are taken, as beautiful in conception as they are practical in application:

"The idea of Reconstruction, of a simple return to pre-war conditions, has gradually been supplanted by the larger and worthier idea of a better world after the war. The experience through which the country has passed has enlarged its sense of what is possible, and at the same time quickened its sense of what is fair and right."

Even more illuminating is this (and it seems but fair here to beg the patience of one's readers lest they think this story is visionary and impractical, to say that without this preamble, the real vision of what the British themselves think of their own reconstruction problem could hardly be here presented, even in skeleton form, in a scant page of matter):

"Reconstruction . . . is concerned both with the questions which will arise in the natural course, in this and every other country, when the nation is switched back into the activities of peace-time; and it has to give shape and satisfaction to the strong feeling which has arisen in all sections of the community, among men and women of the most widely differing opinions and outlook, that there is very much to be ashamed of when we look back to the conditions of July 1914, and that out of justice to the living and out of reverence to the dead we are called to rebuild the national life on a better and more enduring foundation."

These words express better than any of mine, the underlying ideal of reconstruction here in England. It must not be a mere readjustment, or even a reëstabishment of pre-war conditions. Its most important phase, in every one's mind, is the creation of a new system, a new ideal, a new plan for industry, for labor and in some lines at least, for government.

Relocation of Men in Industry

Practically, the two greatest tasks in any getting of a war-pursuing nation back upon a peace footing are demobilization and relocation of men in industry. It is such a problem which confronts the United States. Already our industries are saying to our government, "Just let us alone and we will reconstruct ourselves." Our national idea seems to be to get back to what we were, then to hurry up and make up for lost time; but, except in a few scattered instances, rarely is it to remake either an industrial or a labor policy. The United States Government has no Department of Reconstruction, and as one government official engaged in an attempt to do some constructive work along these lines said to the writer just before he sailed, "If we *do* get a reconstruction policy and start it working, it will probably begin to function just after our readjustment has completed itself!"

But Great Britain feels that she faces a much larger problem than is contained in the mere demobilization of the armed forces, the getting her men back at paying jobs, the resettlement of civil war workers, the releasing her industries from the many governmental restrictions under which they have had to operate for four long years. She feels that there are conditions everywhere which should be changed, must be changed. Old ideas must give way. Tradition must go by the board. Because "it was always so" is no longer a reason for its being so now. And because this feeling is so strong everywhere, just as the feeling was so strong everywhere in the darkest days that "England must win," so does it seem as if from these throes of a Reconstruction which is more than a relocation, readjustment, and resettlement, but which is nevertheless to be kept upon a severely practical basis, must come a much more prosperous, much more alive and much more efficient industrial mechanism . . . and very largely, a better social and labor mechanism.

Importing and Distributing Raw Material

The problem in England begins with shipping. What ships, how many ships, for bringing men home, for bringing in food, for importing raw materials, for exporting finished products. Next, raw materials. Leather and cotton, wool and metals must be secured, shipped and divided among manufacturers. There is to be an international scramble for what raw material is available or can be quickly produced, for the world is short of primary material of all kinds, due to the taking of men from production to war, lack of fertilizer, discouragement due to difficulties of merchandizing during the war, etc. Industries must be graded according to national importance no less in the raw-material-short days of reconstruction than during the war . . . the unessential industry must give way to the essential, a thing in itself revolutionary in Great Britain in times of peace.

Raw material secured, who shall say to whom it shall go? Government? It might work well in the United States, for the United States has only the tradition of democracy behind it. But England is feudal in its generation, and class pride and prejudice are as strong among some as patriotism. If Government interferes too much in times of peace, Government may be overthrown. Now, mark the wisdom here shown . . . the government has decided *not* to ration raw materials to individual industries, but to industries in a group. Representative Councils, made up from both Employers and Trade Unionists will be created within the principal industries, and these will decide when rationing is necessary, as between manufacturer and manufacturer.

With shipping, raw material and distribution of raw material out of the way comes the transportation problem, the remaking of neglected roads, the future of a run-down railway system, already realized to be archaic in many respects if splendid in others, the expansion of the canal system, the development of aerial transport . . . and here, too, comes in the matter of the dumping of army stores upon the nation and the way, for instance, in which thousands of motor trucks, miles of wire, tons of manufactured articles bought for the army are to be delivered back to civil life without dislocating the industries and impoverishing the labor which produces such material.

Next comes the reëstablishment of the labor force, the transforming of an army of soldiers into an army of workers. The demobilization scheme has already been taken up by the present writer, as handled both at home and here . . . civil war workers' reëstablishment is a story in itself; coöperation between employer and employee.

But after the labor, the material, the factory and the transportation are all brought together comes one of the ideals of reconstruction . . . in what spirit is the work to be done? "Increase the national output," is suggested by many as the chief ideal of the new order, with the idea that debts cannot be paid nor the condition of workers improved nor the cost of living reduced unless the new efficiency of production is held as the first consideration. But here comes the returning soldier who has sacrificed time, sometimes health and always his producing force, to say that the low-paid conditions of an earlier era are gone for good, and that the pre-war condition of a continual state of armed neutrality between employer and employed must be altered. And so the British laborer and the British employer are both brought to understand that increased output and improved laboring conditions must go hand in hand . . . and the world beyond the sea can here show the way. True, we have yet to teach it in its entirety to ourselves, but we have a thousand industries now, where Britain had one before the war, where the most ideal of working conditions and the highest of wages have gone hand in hand with vastly increased output and high profits to the business. It took American standardization and efficiency to manufacture cheap automobiles, typewriters, harvesting machinery and super-accurate watches at an absurdly low price while keeping working conditions and wages on the highest plane.

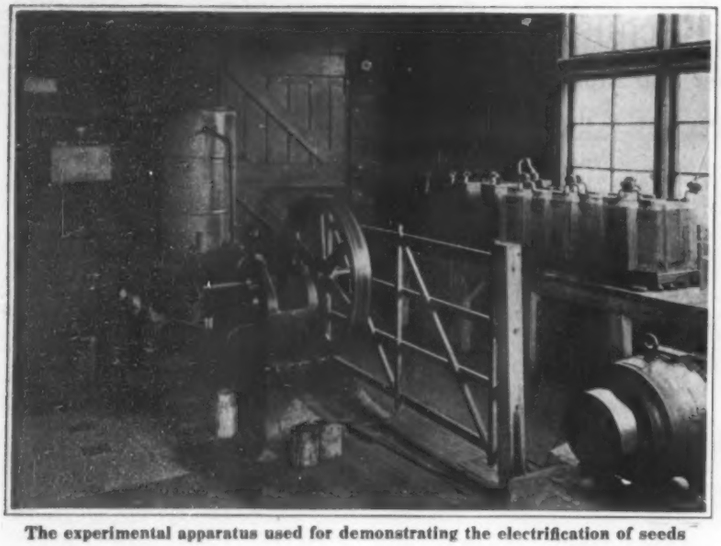
With Great Britain this is no longer a dream . . . she is putting it into effect. What is known as the Whitley Committee on Industrial Reconstruction has done a noble piece of work, which is even now bearing fruit. Broadly, it consists in the establishment in the highly-organized industries of joint councils of employers and trade unionists. They are both national and local to individual industries and in addition they are, according to a pronouncement of the Ministry of Labor, "the normal channel through which the Government will seek the experience and advice of industries." It is generally held that the establishment of such councils is the most promising development of the new ideals of reconstruction which have come to be as a result of the war, and that there are few factors which will more happily aid in the solution of the greatest of all problems of the day, the labor problem.

Amelioration of working conditions has been a reformer's by-word for years. . . . England's idea now is not amelioration by small changes, but a sweeping "deal" by which the laborer will get what he should have to produce his best with the greatest happiness to himself as well as the greatest profit to his employer. The whole industrial fabric is being closely investigated, and hours of labor, wages, regulation of earnings, health, sanitation, safety, accidents, insurance, nightwork, overtime, holidays, continuous hours, meal times and hours, dangerous trades, industrial control and child labor are all under the microscope of the Government as well as the scrutiny of those who favor the old system and those who clamor for the new.

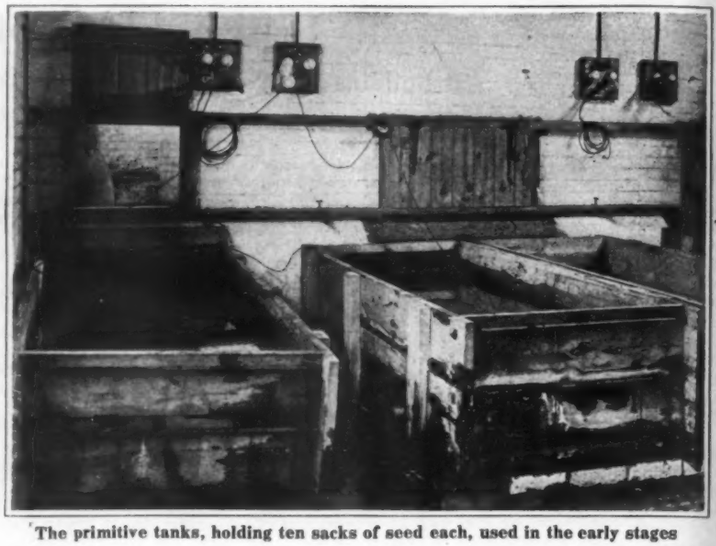
A New Rural Life

In the ideals of reconstruction comes a new rural life, better land laws, the use of land for public rather than private interests (a story to be told at greater length later), the reclamation of waste land, the parceling of it to soldiers and sailors, the increase of agriculture and the diffusion of a new school of thought in old agricultural circles. Health, housing and sanitation are receiving attention as never before; and adult education, that the nation need not wait on the younger generation for a speedy acceptance of the new ideals of national life, has a prominent place in the plans of those to whom British Reconstruction is a gospel of regeneration, not a mere readjustment of a dislocated empire to its pre-war days.

WE wish to direct careful attention to the series of articles from our special correspondent in Europe, Mr. C. H. Claudy, which will continue to appear for several months in this journal. Mr. Claudy has completed his work in England and is now in France. The article on the British Navy (Feb. 1st) and the present article, British Ideals of Reconstruction, will be followed by others on British Plans for Reconstruction, English Railway Reconstruction, From Fighting Line to Factory, England's Scheme of Demobilization, England's Aircraft Industry, British Munitions, Future of British Flying, etc. As our correspondent is following the same general line of investigation in France, it will be realized that the whole series of articles will form a valuable compendium of information, which will be of the highest assistance in the working out of the same industrial and social problems in the United States.—EDITOR.



The experimental apparatus used for demonstrating the electrification of seeds



The primitive tanks, holding ten sacks of seed each, used in the early stages

The Electrification of Seeds

A Revolution in Agriculture

By Charles A. Mercier, M.D., F.R.C.P., F.R.C.S.

FROM time to time, arts have been revolutionized by the efforts of individual men, often, men not brought up to the art, but practicing in a very different occupation. Arkwright, a barber, revolutionized the art of spinning; Cartwright, a clergyman, revolutionized the art of weaving; Watt, a maker of mathematical instruments, revolutionized every heavy industry; Rowland Hill, a schoolmaster, revolutionized our communications by devising the penny post; and Mr. Fry, an electrician, is revolutionizing the art of agriculture.

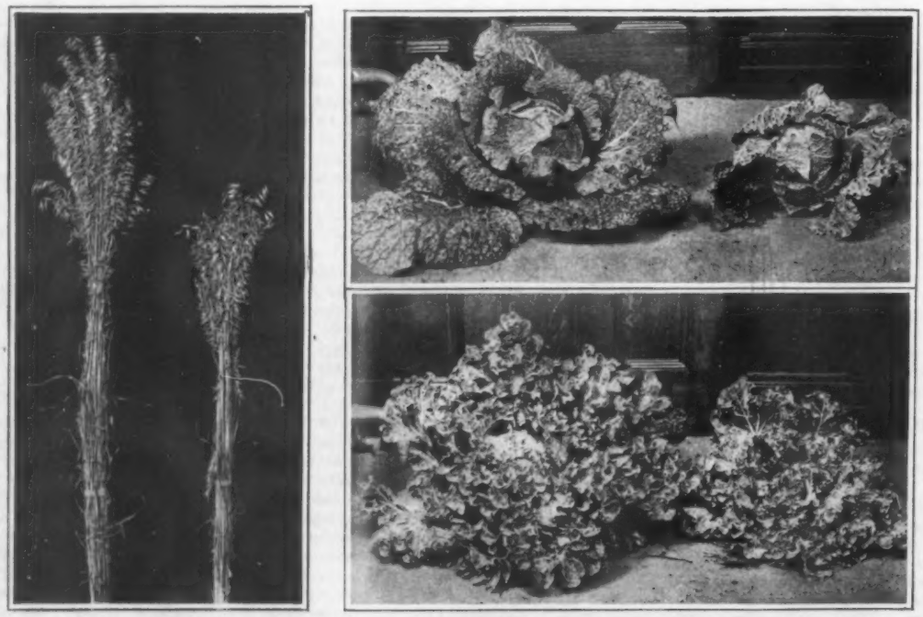
For to produce a large increase in the yield of corn and other crops, and at the same time a material improvement in quality, and to do this without any increase in the farmer's expense, without requiring any additional implement on the farm, or any new acquirement of skill, or any additional expenditure of time, on the part of the farmer—this is nothing short of a revolution in agriculture, and this is what Mr. Fry has done.

Electricity has long been applied to growing crops, and has had a decided effect upon them in producing more rapid and more luxuriant growth; but to subject a plant to electricity, either continuously or at intervals during the whole period of its growth, requires a considerable supply of electricity and more or less continuous attention; to apply it over large areas of many acres must necessarily be costly; and to apply it over hundreds and thousands of acres is scarcely practicable, especially as the installation of wires, etc., must necessarily interfere with the operations of agriculture. For horticulture it is no doubt practicable, and may be found useful and even profitable, but the difficulty of applying it on a large scale to agriculture is evidently considerable, and Mr. Fry turned his attention to the electrification of seeds, which is open to none of these drawbacks.

The process is novel. There was no previous experience whatever to go upon, and the inventor had to feel his way gradually to success by the tedious process of trial and error, making many mistakes on the way, suffering many disappointments, checked in every direction but the right one, and learning from every failure the way to success. Beginning first in a few pots, the experiments were soon extended to a patch of garden ground; then a neighboring farm-manager was persuaded to sow, very reluctantly and sorely against the grain, a few plots of agricultural land. Seeing the results, he was less reluctant the next season; and as year by year his crops from electrified seed continued to contrast favorably with those from untreated seed, he sowed a larger acreage with the former, until now he sows no unelectrified seed except a small patch in each field for comparison; and from being an utter sceptic, he is become an enthusiastic advocate of the process.

Farmers meet at market and talk about the weather and their crops, and thus news of the process spread in the neighborhood, and one farmer after another adopted it, first only as a trial, and on a few acres of ground, but when they had had experience of it, upon larger and larger acreages; until at the present harvest 150 farmers have reaped grain growing from electrified seed. Farmers are a cautious and conservative race, not eager to adopt new methods until these have been well tried at other people's risk, and have had their value proved beyond question; and those who tried the electrified seed for the first time tried it upon a few acres only, so that the total acreage thus sown last season was not much more than 2,000; but 2,000 acres is quite enough ground to yield a thorough and satisfactory test, especially when the trials are scattered over many different parts of the country, on many different soils, from the infertile sands and newly plowed heaths of Dorset to the chalk around Salisbury Plain and the stiff clays of Cheshire. No doubt a much larger acreage would have been sown with electrified seed if efforts had been made to spread a knowledge of its advantages, if the inventor had not waited with the intention of perfecting his process and discovering all its possibilities before taking any steps to make it known.

But it seems that the possibilities are almost unlimited. The more he investigates it, and the wider the scope of his experiments, the greater are the advantages they reveal. As it is, quite enough is known, first to prove that the process is one of very great value if properly conducted, and second to enable it to be conducted to the best advantage, eliminating with certainty all the errors that vitiated the results in some of the early experiments, and ensuring without fail a substantial increase in the crop. This is enough to justify, and indeed to demand, the use of the process. It would be unjustifiable to withhold the process longer on the ground that all the possibilities it contains are not yet become available in practice; and the inventor has at length been prevailed upon to place it on the market as it is.



Oats, cabbage and kale grown from treated (left, in each case) and untreated (right) seed, under identical conditions

In the first place, there is a notable increase in the yield of grain from the electrified seed. An average crop of wheat in Great Britain is about 30 bushels per acre, of oats 48 to 80, of barley 32 to 40 bushels. If electrified and unelectrified seed of any of these crops are sown separately in the same field on the same day and treated in every respect alike, it is found that, according to the nature of the crop and other circumstances as yet imperfectly known, the yield of the electrified seed exceeds that of the unelectrified by from four to 16 bushels. The average of the considerable number of trials whose results are at present known is between 25 and 30 per cent of increase.

The quality of the crop also, as indicated by the weight per bushel, is im-

proved. The increase in weight has ranged from one pound to as much as four pounds per bushel. This does not seem a large proportion of the weight of an average bushel, which is about 63 pounds; but the normal variations from this average weight are not wide. A poor sample of wheat weighs 60 pounds to the bushel; a good sample 64 pounds; 66 pounds to the bushel is an exceptionally fine sample. It is evident that a gain of from one to four pounds to the bushel may make all the difference between poor and good, between good and excellent. It means better milling quality, less offal, and more flour per bushel. It may mean all the difference between grain that can be used only for milling and grain that can be used for seed.

Even this is not all the advantage to be gained by using electrified seed. Besides the increase in the bulk of the yield and the increase in the weight per bushel, there is an increase in the straw that may be very important. In the first place, the electrified seed throws up more straws from each seed than the unelectrified. In one field of oats the increase was characterized by a previously sceptical expert as "astounding," for whereas the bulk of the unelectrified seed had thrown up only two straws per seed, the electrified had thrown up five. In the second place, the straw growing from the electrified seed is longer than that which grows from the unelectrified. The straw is in some cases only one or two inches, in other cases as much as eight inches, longer; but in every case the length is increased. In the third place, and this is the most important, the stoutness and the strength of the straw are increased. From this it results that the crop is less liable to be laid by storms of wind and rain. In one case the visitors to a farm, who had gone for the purpose of inspecting the electrified and unelectrified crops growing side by side, asked the farmer to show them the dividing line between the two. "Go and look for yourselves," said he. "No one but a blind man could fail to see the difference." And truly it was so. On half the field nearly the whole of the barley was lying flat upon the ground, laid by the recent thunderstorms. On the other half not a straw was laid; the whole crop was standing upright waiting for the reaper.

Even those that have been mentioned are not all the advantages that may be gained from electrifying seed corn. It seems that corn growing from seed thus treated is less susceptible to the attacks of fungus diseases and wireworm than that growing from seed that has not been treated. Little can be said at present on this score, for the observations are as yet incomplete, and experiments are in progress that will test the matter up to the hilt. All that can be said at present is that there seems to be a great likelihood that the process is protective against smut, bunt, rust, and other fungus diseases.

So much for the advantages of the process; now what of its disadvantages? These are few, and can scarcely be considered serious. The first is that if the process is not properly carried out, the result will be disappointing. This can scarcely be considered a drawback to the process itself. It is a simple process, easily performed, occupying only a few hours, and no more difficult than the process of dyeing a parcel of yarn or sterilizing a surgical dressing; but, like these operations, it requires the use of a certain technique, and cannot safely be entrusted to inexperienced hands. Properly performed, it can neither damage the seed nor fail to enhance its value.

Secondly, the effect produced upon the seed is not permanent; it will retain its enhanced efficacy only for about a month after electrification, if kept in a dry place. It is therefore desirable that the seed be sown promptly after it has been electrified. The drawback is not a serious one, but if not known and allowed for, it may lead to disappointment and to undeserved discredit being thrown upon the process.

Thirdly, the advantage accruing from the process is not uniform. The process always results in an increase in the yield of the seed; but whether the increase will be mainly in the grain or mainly in the straw, and what percentage of increase it will effect, are unpredictable. The best results are often obtained on poor land, where the untreated corn gives but a small return, but this is by no means uniformly so. What the conditions are that go to secure the largest increases are at present unknown. Doubtless they will be ascertained in time, when more experience has been had, and the rationale of the process is better understood; but at present we cannot say beforehand whether the crop will be greatly benefitted or only moderately benefitted.

Seed being dried in a kiln after electrification

The process is very simple in principle, though it requires a good deal of care and of experience in carrying it out. A current of electricity cannot be passed through a heap of dry seed; the grain must be steeped in water that contains, in solution, some salt that will act as a conductor. Such a solution is placed in a tank, the seed is steeped in it, and a weak current of electricity is passed by means of electrodes of large surface attached to two opposite end walls of the tank. The seed is then taken out and dried.

This is the outline of the process, but the outline needs a good deal of filling in. The kind of salt employed to enable the water to conduct the electricity is not without importance. Seed that is to be sown on one kind of soil will yield better results with a calcium salt, and seed that is to be sown on another kind of soil will yield better results with a sodium or some other salt. One kind of seed will need treatment for so many hours, and another kind for many more or fewer. Barley, for instance, needs twice as long treatment as wheat or oats. The strength of the solution and the strength of the current must be appropriate, and are not necessarily the same in each case. The drying is very important. The seed must be dried at the right temperature, neither too rapidly nor too slowly; and it must be dried to the right degree, neither too much nor too little.

All these matters are important, and it is possible that variations in them are responsible for the variety in the results that are obtained. The proper treatment has to be ascertained by long and copious experiments with each kind of seed, and it is only by degrees that the proper treatment has emerged from these experiments, which have now been in progress for six or seven years.

It will take many years before all the benefit that can be obtained from the process is finally arrived at. At present, it has been worked out only for wheat, oats, and barley; but experiments have shown that its advantages extend to many other kinds of seeds. Turnips and other roots, maize, rice, cabbage, and many other plants grown from seed are known to benefit; but for these the process is not yet recommended, because the exact conditions have not been thoroughly ascertained. Some of the most remarkable results have been obtained from electrifying seed potatoes; but the results are not yet sufficiently uniform to justify its application on a large scale to potatoes.

Electrification of seeds will be adopted on a very large scale in England for next year's harvest. Every farmer who has tried it once upon a small acreage will use it freely; and though it has scarcely been advertised at all, farmers talk to one another, they see the articles written by experts who have inspected the crops; and the amount of seed that will be electrified for next year's harvest will be practically limited only by the pacity of the plant laid down for the purpose. In Great Britain the process is established.

So emphatically true is this that Dr. Wray, the United States Inspector in Charge in Great Britain, after an extended tour of inspection of farms, has advised his Government to have immediate trials made in every State of the Union. To my mind, the time for trials is past. Further trials are but waste of valuable time. We must face the fact that there is a shortage of food all over the world, and that this shortage will be most acutely felt next year. It is next year that the increased production will be required; and further trials, which could tell us no more than we know already, would only postpone the adoption of the process for another year. It is wanted now, and badly wanted.

A Well-Equipped Lift Bridge

NUMEROUS and novel safety precautions are taken in the operation of the Fourth Street Bridge in San Francisco, by interlocking the motor, brakes and end lock-gates in such a manner that it is impossible for the operator to start the motion of the bridge until the end and safety gates at each end have been lowered. Until all four end gates are entirely down, it is impossible to make the electrical connection with the motors that raise the bridge.

After the bridge starts to rise, it is impossible for either of the four gates to be raised, until the bridge is again lowered, and locked. While the bridge is up it is impossible to make electrical connection with the motors that raise the gates.

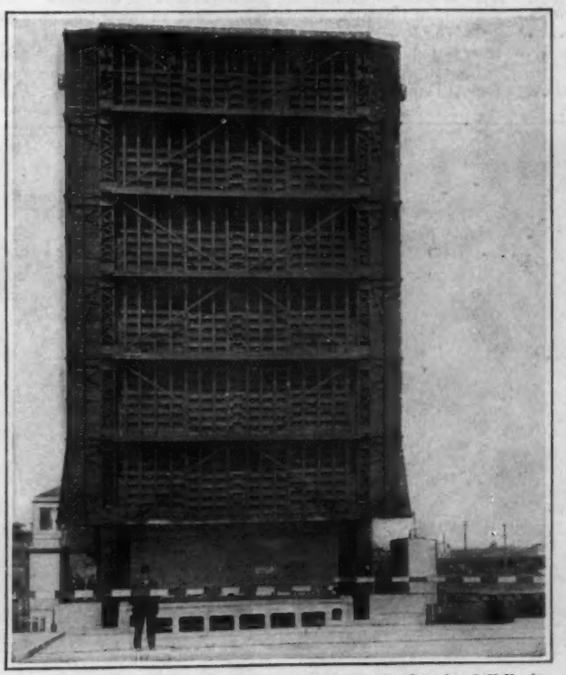
One of the most novel features of this bridge is the operation of the semaphores placed at both sides of the bridge to warn navigation officers of the position of the bridge at night. The semaphore consists of a semicircle lens, one-half of which is red and the other half white. An electric lantern is pivoted so that when the bridge is down it shines through the red section of the lens which is the danger sign, notifying navigation that the way is not clear. When the bridge is raised, the semaphore will take such a position that the lantern will shine through the white section of the lens, informing navigation that the way is clear.

The locking device can be seen in the photograph. A motor operates a shaft that extends across the end of the bridge, and by means of eccentric connections, it can be locked or unlocked by operating a switch in the bridge operator's room. It is impossible to unlock the bridge until all four safety gates are down. It is also impossible to operate the motors that raise the bridge, until the bridge is unlocked. When the bridge is unlocked, connection can be made with the bridge raising motors.

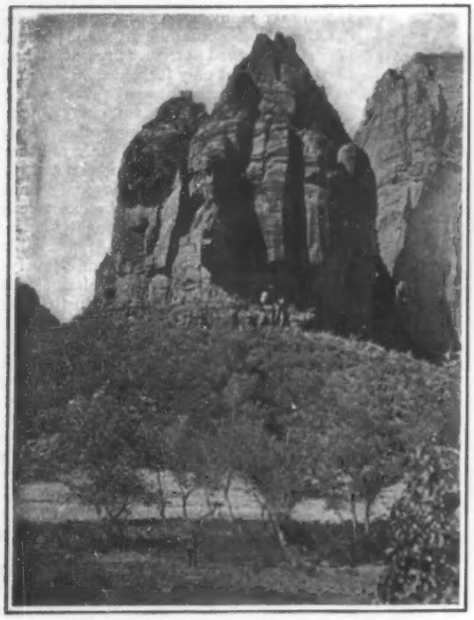
An automatic cut-off or short-circuiting device is provided to set the brakes when the bridge, in opening, reaches a nearly vertical position, and in closing, a nearly horizontal position.

A series of electric light indicators tell the position to the operator of the bridge at various stages: as follows; locked, unlocked, bridge fully closed, bridge nearly closed, bridge nearly open, bridge free, and also when raised to the proper position to permit boats to pass.

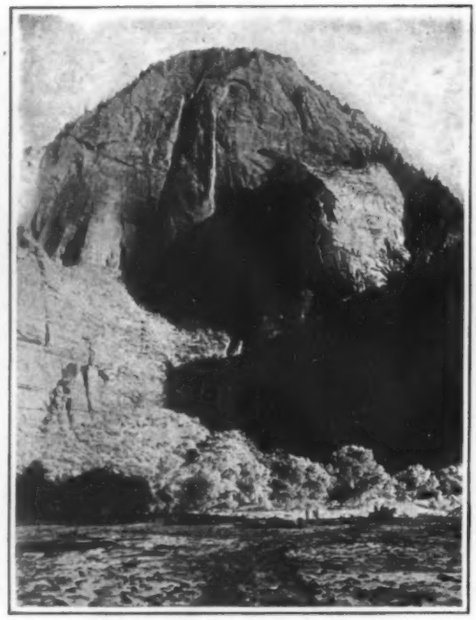
An unusual feature is a life saving apparatus maintained at this bridge, to save people who may jump or fall into the river at this point.



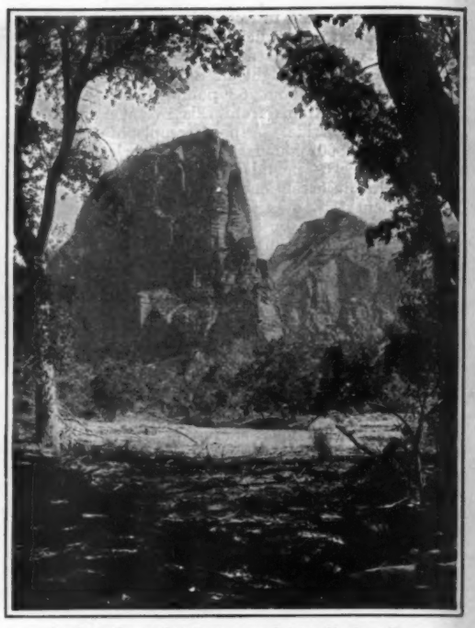
The Fourth Street Bridge, San Francisco, raised to its full limit



The Pipe Organ, a curious rock formation



Cable Mountain, Zion Canyon



A vista through the trees of Angel's Landing

Zion Canyon and the Colob Plateau

A Little Known Region of Southern Utah Destined to Become World-Famous

By LeRoy Jeffers, F.R.G.S., Secretary Bureau of Associated Mountaineering Clubs of North America, etc.

ALTHOUGH a hundred miles distant from the nearest railway, the Zion National Monument in southern Utah is destined to be visited by an increasingly large number of travellers. Leaving the Los Angeles and Salt Lake Railway at Lund, one may travel by auto across the desert to Zion Canyon, by way of Cedar City. On every hand is sage brush, greasewood, rabbit brush, and shad scale, while the prickly pear livens the landscape with its bright magenta flowers. Jack rabbits and prairie dogs run to cover as we pass; and, with the increasing heat, the air gathers whirls of dust that rise in columns for five or six hundred feet above the floor of the desert, and travel rapidly along for a mile or two. Volcanic mountain ranges purple in the distance, or loom with deceiving reality in mirage. If one is fortunate he may see a phantom city, with its buildings and steeples, seeming to lie but twenty miles across the desert sands. We cross a ridge of almost pure iron that is dotted with cedars, while another is composed of black, contorted volcanic rock. In the foot hills are great flocks of dirty brown sheep which give Lund importance as a shipping point for wool.

Near Cedar City there are glimpses of red and yellow walls, while beyond we follow for miles beneath the yellow-gray and slate-colored cliffs of the Hurricane fault, the greatest of all known faults in the world. On the right are the little known Pine Valley mountains, while beyond on the road to St. George is a brilliant patch of cherry-red sand, an unmistakable landmark which is seen from the far distant heights of the Colob Plateau. Near Toquerville is a cluster of black, volcanic cones; while, above the village, lines of varicolored buttes rise one upon another in imposing array.

After a very steep ascent, there opens before us a glorious view of temples and buttes aglow with marvelous coloring in the setting sun. Towering above is the Great Temple of the Virgin, locally known as Steamboat Mountain, 7,650 feet, the highest in the region. From the banks of the winding, treacherous Rio Virgin, slopes of green lead to a desolate desert region extending to the base of the red cliffs, which are dotted here and there with pine and cedar. Then follow vertical walls of gray and white, streaked with color from a vermilion butte which crowns the mountain like the upper deck of a steamboat. Its brilliant walls are topped by a rich green forest of pines, the whole making an unforgetable combination of form and color. Looking upward toward the Colob Plateau we see the most curious red and white domes; while, across the river, the temples of Smithsonian Butte are painted with soft reds and browns.

We pass Grafton, Rockville and Springdale, curious old Mormon settlements of stone and adobe, on the banks of the Virgin and of the North Fork near its entrance to Zion Canyon. Tall poplars line the streets, through which there flow streams diverted from the river, life-giving and purifying alike for man and beast. A new era dawned for the valley with the summer of 1917 when it was first opened to automobiles, and fruit and produce were in increasing demand. So important are the scenic wonders of this little known region that, in the spring of 1918, the President increased the size of the Monument reservation from 15,840 to 76,800 acres.

Near Springdale we have an unequalled view of the Great Temple with its sublime precipice of 2,900 feet. Beyond, a canyon on the right is spanned by a natural bridge in process of formation; while, on the opposite side, the fantastic Towers of the Virgin astonish us with their unusual architecture, and their vivid hues of red, of orange and of white. From a climber's point of view, few of the sandstone walls of the valley are attractive during the heat of summer. Circuitous routes are necessary to reach the summits of these tremendous cliffs and Yosemite-like domes, almost none of which have been ascended. Viewing the Great Temple from all sides, one finds it promising only from Springdale, and, on one of the warmest days known to the region, I found myself far up its heated cliffs. Here was a magnificent view of the valley, painted in richest browns and reds and enlivened by bright green along the river. Far across the intervening heights were the upper reaches of the Parunuweap, and distant purple capes and headlands leading to the Grand Canyon of the Colorado. An insufficient supply of water finally forced my retreat to the river.

By far the finest effects in Zion Canyon are seen at sunset and at sunrise. Then the great sandstone walls which surround one glow with the most exquisite and unusual colors, and one lingers long in worshipful silence. Brown and red are the cliffs, while above they are cherry and white; elsewhere there are magenta spaces, and layers of smooth, fresh chocolate seeming as if they were but newly cut. Where streams have fallen, the cliffs are seamed with black. But most beautiful of all are the rosy pinks which liven the walls, or mingle delicately with the white. More rarely there are golden-yellows crowning the white, and completing a color harmony of which one never tires.

Looking south from the eastern rim of Zion Canyon

Awakened in the cool of the morning by the sweet voices of birds, one may gaze upward a couple of thousand feet from the Wylie Camp to the summit of a tree-fringed precipice that seems almost to overhang one. Proceeding up the valley one is continually impressed with the amazing architecture and sculpturing of the Canyon walls and giant buttes. The beauty of the Gothic cathedral is on every hand. Here are immense amphitheatres with colossal buttresses; vast dome-shaped mountains recessed

with crypts where the rock has shelled off; and innumerable towers and spires shimmering in pink and in purple. Giant bosses of colored rock overhang royal arches, and temples and colonnades are on every hand. On the face of one great cliff is a rectangular doorway, probably 50 feet in height, which resembles the entrance to an Egyptian tomb. One magnificent butte, standing far out in the canyon, rises to nearly the height of the surrounding walls, and is called Angel's Landing; another with fluted columns is named the Great Organ; while still another with wonderful walls of white tipped with sunset yellow is known as El Gobernador.

The eye is never weary, for the varied greens of the canyon floor offer pleasing contrast to its brilliant walls, and the base of one great cliff is embroidered with vines and yellow columbines. At Cable Mountain are two 2,700-foot wires which bring down lumber into the valley from the forest on the summit. Until recently one might make a rapid and rather thrilling ascent of the mountain by clinging to the sling on which the timber is secured. One of the most comprehensive views of the region from above is at Hick's Point, which is reached by climbing out of the canyon from the base of Cable Mountain. On the ascent one passes through a narrow gorge with overhanging walls of great height, and afterward views a mountain of cross-bedded sandstone laid out like figures on a cake. I have forced my way up several summits in the wild unmapped country east of the canyon rim, finding ample exercise, but no water.

At Raspberry Bend the river loops between precipitous walls and great domes. These are ever varied, for below are 2,000 feet of bright red Triassic sandstone, while above there is almost the same thickness of white Jurassic sandstone. This in turn is often topped with pink or blood-red layers. One finds surprisingly little talus at the base of the cliffs, for the rushing river has long since taken it away. Down the face of a 2,000-foot cliff a tiny waterfall glistens white in the sunlight. Pausing on little ledges, and then leaping 1,000 feet in the wind, it is torn to ribbands, and reaches the valley in colored mist. Now and then an eagle sails away toward the distant heights. Following up the stream on horseback between walls over 2,000 feet high that rapidly narrow until the river is but a few feet across, we were finally turned back by the depth and swiftness of the current, against which the horses were unable to proceed.

To the west of Zion Canyon, and over 3,000 feet above it, lies the Colob Plateau. Probably visited as yet by less than a score of travellers, it will eventually attract many who seek the finest canyon scenery that Nature has to offer. When I am asked to compare one mountain with another I seldom comply. So with our National Parks and Monuments, each is different, making its own appeal to the lover of the beautiful and the grand in nature. But when I seek the mountains for my vacation, I do not feel it has really commenced until I am in the midst of their highest and wildest scenery. That which satisfies must equal or surpass the finest with which I am acquainted. Consequently I classify scenery according to the grandeur of its appeal as primary or secondary. I do not attempt to compare Zion Canyon, and those seen from the Colob Plateau, with the Grand Canyon of the Colorado. They are dissimilar in scale, but they are each of primary appeal. Studying either one does not deaden the charm of the other.

Great Temple, an imposing spot in this remote region

From the floor of Zion Canyon to the extremity of Horse Pasture Plateau, which overlooks it on the west, is a trip of 35 to 40 miles over some of the roughest roads and sheep trails to be found in the mountains. Most of the way is decidedly up hill, and one has time to enjoy the distant view of pink and vermillion cliffs and purple mountains. The sandstone of the Lower Colob is very unusual in appearance, in some places resembling a multitude of red beehives. Nearby a 1,000-foot cone, dotted with trees, reminds one of a dish of strawberry ice cream. We climbed the heights above the canyon of Coal Pits Wash, forcing our horses for miles up the most inhospitable walls and through continuously resisting undergrowth. We also visited Le Verkin Canyon, riding through Hop Valley with its brown walls and sandy floor. The view at the junction with the canyon is remarkable, the lower gorge of Le Verkin being brown, while the upper walls and domes are vermillion. Nothing could be more striking than this intense color against a bright blue sky with white clouds. At the head of the canyon are Le Verkin Breaks, where great tree-covered masses of earth have slid downward from the upper slopes.

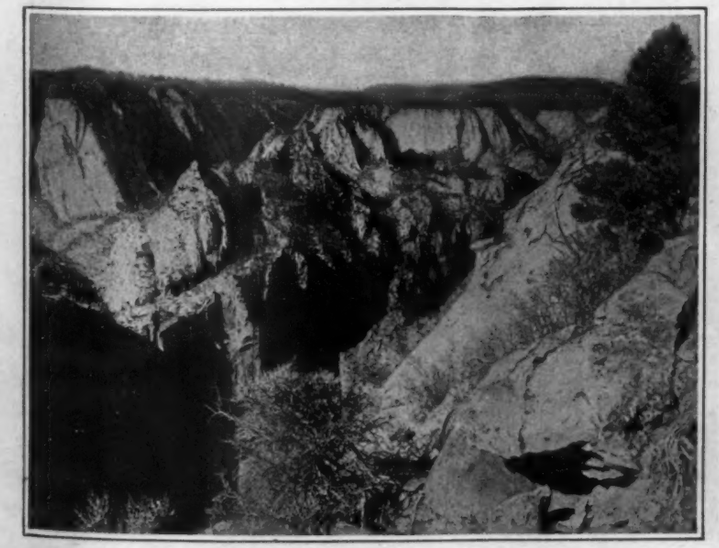
It was a long, hard climb to the Upper Colob, but eventually we came to miles of quaking aspens and to the welcome waters of Blue Spring. Here were vast flocks of sheep which pasture on the plateau, and annihilate for years all the natural beauty of the forest. In order to obtain a comprehensive view of the region, we climbed a distant mountain that overlooks the deep and narrow cleft of the North Fork of the Virgin. On the way we saw white and pink Sego lilies, and great fields of dandelion and larkspur, gleaming like cloth of gold embroidered with blue; while, in the distance, was the rich color of the Pink Cliffs.

From the Blue Spring it is a steep descent through aspen, yellow pine and manzanita to the long point called Horse Pasture. Before reaching Potato Hollow we skirted the head of a symmetrically rounded side canyon, from whose depths rises a Yosemite-like dome. Here we watched the softened colors of the sunset indescribably blending with the painted landscape. In the morning we followed the rim of the Plateau for some hours to its farthest extremity above Zion Canyon. It was rough work on horseback forcing our way through oak and manzanita, but we found a fine grove of yellow pine, and everywhere were the deep magenta, yellow, pink, and white blossoms of the prickly pear. On the way were wonderful views of an immense canyon located well to the west of Zion Canyon. It has been referred to as the Great West Canyon, and through it flows North Creek, one of the forks of the Virgin. No one is known to have penetrated its many miles of splendid scenery or to have climbed any of the remarkable buttes that rise within it. Accompanying us was a famous cougar hunter who was born on the Colob, and who intends some day to find a way down the sheer cliffs that guard this virgin canyon. The whole Colob region, as well as that of Zion Canyon, is as yet unmapped, in detail. Great West Canyon has marvellously colored slopes and side canyons, and from the rim, one may look down on a rolling sea of white sandstone brilliantly streaked with pink. Its isolated buttes have vertical walls of vermillion, while their summits are covered with acres of trees. In the wall of one great butte is a tremendous archway, hollowed out like a cave. The view from the final point of Horse Pasture is rugged in the extreme. Great temples and buttes of varied architecture and coloring are isolated by narrow V-shaped canyons, while a couple of miles below in the distance, we get a glimpse of the green floor of Zion Canyon.

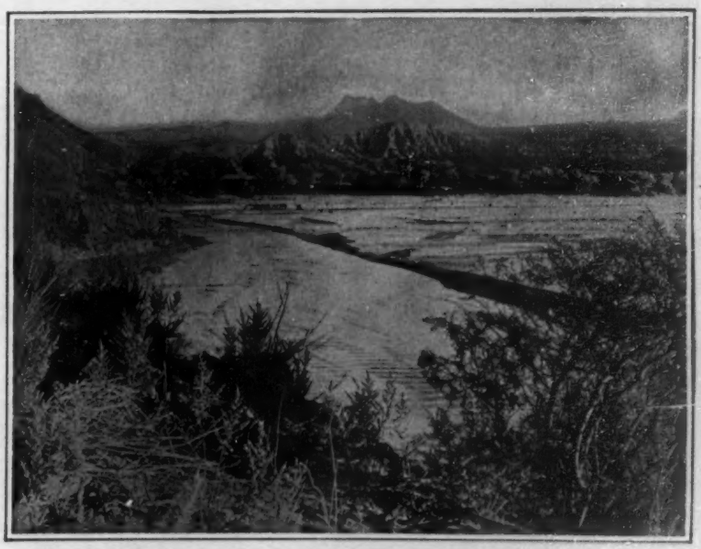
After a rough journey back to the river, we left in the quiet of the evening just as the full moon appeared above the mystical towers and temples of the Virgin.

Mending Rail Ends

INSTEAD of cutting off and discarding the worn ends of rails one railroad in the United States welds them into shape again by the oxy-acetylene process. From February 1st, 1917, to May 3d, 1918, the ends of 6,246 rails in the main line were built up in this manner at a cost of 43 cents per rail-end. The material used is steel obtained from rails; this makes a better bond than the rods usually supplied for oxy-acetylene work. The process has been found both economical and satisfactory, failures being few, not exceeding two or three per cent.



The view from Colob Plateau, looking northeast toward Zion Canyon

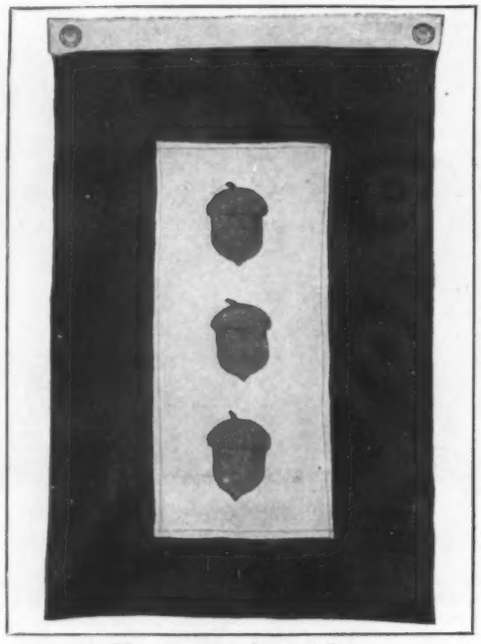


Approach to Zion from the Rio Virgin; Smithsonian Butte in the center

The New Service Flag

THE use of a national service flag to honor the men in our army and navy was a very happy thought, as was attested by the widespread and practically universal use of this flag throughout the country, although it was in no sense an official flag. Every home which could boast of a blue star was proud to exhibit the flag in its window. Commercial concerns were also proud to make as large a showing upon their service flag as possible. Indeed, there was a certain amount of rivalry between various concerns as to which could show the greatest number of stars. But the flag represented no special patriotic service upon the part of the concern. It was the soldier who was honored, rather than the company which was for the time being deprived of his services. If the flag had any significance, it was that the company counted the soldier as one of its employes who would be taken back into the company's service at the end of the war. But the war is now over, and over to such a degree that a great many concerns have forgotten their patriotic claims and are making no effort to reinstate their former employes, or if they do reinstate returned soldiers and sailors they do so grudgingly, and seek every possible excuse to turn them away.

A new flag has recently appeared which a few companies are displaying. This is a flag which means far more to the company than the former service flag. It is exactly like the old flag except that the blue stars are replaced with khaki acorns. These acorns represent the returned men who have been reinstated in their former positions. A manufacturer can point with far more pride to a flag of this sort than to the old service flag, because the new flag is an announcement of the fact that he is making good to the men who were drafted into the service, whereas the old flag merely represented the handicap which he had to endure when the men were taken away from him, and, judging by the reluctance of so many companies to reinstate their former employes, this handicap was not very real.



The new re-employment flag

Eliminating Static Electricity in Printing and Weaving

ONE would hardly connect the work of Thales, a Greek philosopher who lived seven centuries before Christ, with the most modern method of eliminating static electricity from paper being printed or cloth being woven. Yet it is the principle discovered by Thales and understood by Franklin and all his successors in electrical science, that like kinds of electric current repel each other and unlike kinds attract each other, that is the basis of the device for eliminating static electricity shown in the accompanying illustrations. Going a step further, another important principle is that if a body have in it a negative charge and an exactly equal positive charge is added to it, it will then have in it no charge at all. While both of these principles are ages old, it is only in the mechanical electric neutralizer described herewith that both have been put to commercial advantage, as for instance in printing on paper and in weaving cloths.

Static electricity set up in the sheets of paper going through a printing press reduces the output of the press and therefore increases the cost of the printing, because the sheets adhere to the press rolls and to other sheets of paper, thereby requiring more handling and a greater time to print any given number of sheets, especially when both sides of the sheet are to be printed. Similarly, cloth threads stick to the rolls in weaving and when charged with like currents are repelled from each other, resulting in a rough torn sliver and an uneven yarn.

The neutralizer shown eradicates these troubles by providing an alternating charge in a conductor placed near the material. Whatever charge there is in the material causes the opposite kind to be absorbed out of the alternating charge, effecting a neutralization that leaves the material without any charge at all.

The neutralizer supplies the alternating charge by means of a small motor generator turning out an alternating current of about 70-volt pressure. This in turn is passed through a transformer, where it becomes a current of high pressure and small quantity ready for delivery to the paper or cloth through a row of metal points enclosed in porcelain blocks inside of the inductor bar shown. Each point delivers a charge of about 10,000 volts, but of so minute a quantity as to be scarcely perceptible to the touch. Rheostats are furnished to adjust the voltage to the requirements of different work. When an alternating supply current is available, the alternator may be dispensed with and the transformer connected directly to the supply circuit.

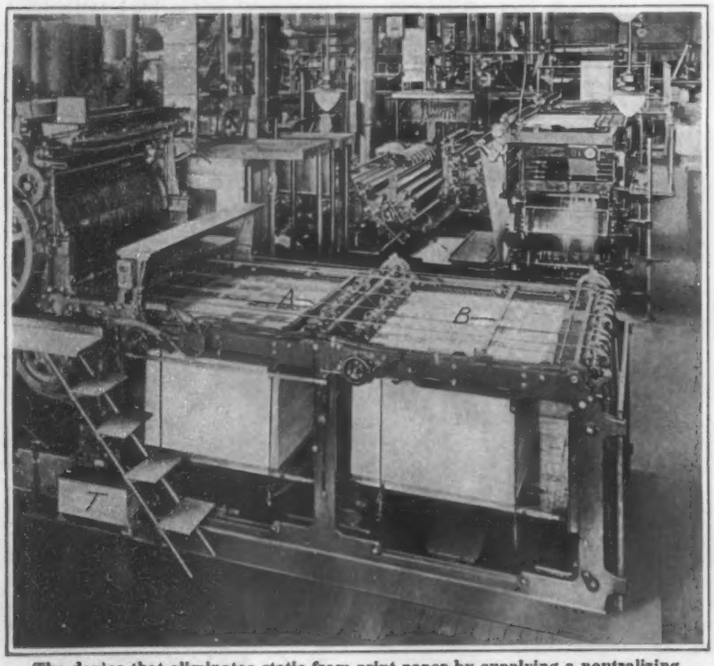
Grading Small Coal by Air Currents

A PATENTED air-grading apparatus for removing the dust and fines from the small coal passing to the washery has been brought out by a British company. For efficient washing the removal of the dust before passing the coal to the washing boxes is absolutely necessary, as not only does the dust foul the effluent water, but even when it has been recovered in the form of slurry its drainage becomes a serious proposition; so much so, indeed, that at many collieries no attempt is made to wash the dust, which is taken out by a preliminary screening, and then fed in a dry state to the washed coal passing to the storage bunker at the ovens. It is obvious, however, that a certain amount of additional dust and fines will be made by passing the dry coal over a screen, whatever type that screen may be.

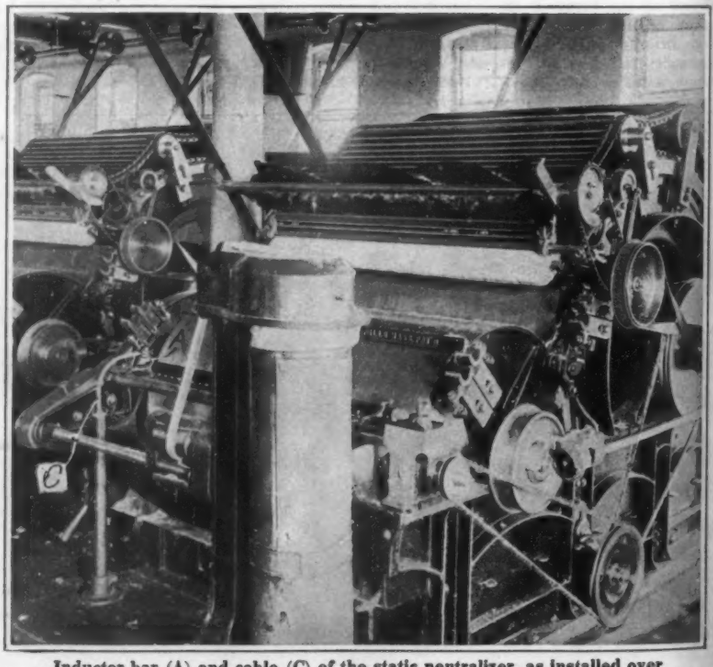
The grading of fine coal by means of a powerful current of air is therefore an interesting departure, which may well have considerable possibilities, especially as the dust taken out by such method will be comparatively free from substances of higher specific gravity than coal.

At a North Country colliery where a grading plant has recently been installed by the company, the coal is delivered to the washery by a bucket elevator, and discharged on to shaking screens. The grading apparatus is fixed immediately under the delivery shute of the elevator, the mixed coal allowed to flow over a hinged weir plate. Immediately under this plate is an orifice through which a powerful current of air is drawn by means of a centrifugal fan. The size of the opening is capable of adjustment by means of a sliding plate. The passing stream of coal is brought nearer to or kept farther from the suction by adjusting the hinged weir plate, so that any desired proportion of small coal can be drawn off. A deflecting plate is fitted into the receiver, which serves to throw the larger pieces of coal to the bottom; the fine dust, passing on with the air through the fan, is finally collected in cyclone separators. These separators are fixed over the briquetting plant, some distance from the washery. The fines are made into briquettes.

The alternative methods of feeding the fine coal, either dry or in the form of slurry, on to the washed coal are at best clumsy and unsatisfactory. Assuming, as indeed is often the case, that the whole of the fines made is used for steam-raising at the works (in which case they can only be fired in the form of semi-wet slurry), their increased steam-raising capacity if fired in the form of briquettes would fully justify the initial capital outlay on the plant.



The device that eliminates static from print paper by supplying a neutralizing charge. Inductor bars at A and B, transformer at T



Inductor bar (A) and cable (C) of the static neutralizer, as installed over the doffer comb of a carding machine

The Giant Blacksmith who works for the world

A BILLINGS & SPENCER forging is hand wrought as truly as the horseshoe on the blacksmith's anvil.

But modern science uses, instead of the hand hammer, a great drop hammer which crashes a ton blow down on the white-hot steel, again and again, with stupendous force until the forging is perfected.

Instead of the approximate exactness of anvil forging, Billings & Spencer first cuts a master die out of solid steel —and it is the exact form of that die, gripped in the descending ram of the hammer, which gives every forging shape—which makes every forging exact to the hair's breadth of an inch—which gives every forging such strength as only a Titanic blow can attain.

All the care of hand work—with greater exactness. All the care of hand work—with the economy of modern quantity production. All the care of hand work—with half a century of knowledge, half a century of supremacy.

That is why a giant blacksmith has come into being who now works for the entire world.

In all the days since the Civil War, Billings & Spencer forgings have been making possible great industrial achievements, have been taking their part in industry's steel skeleton, all the world over.

Every Triangle B product is the expression of the Billings & Spencer creed, "Into every forging goes our entire reputation."

B

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Drop Forgings ℄ Hand Tools ℄ Forging Machinery

The Motor-Driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Climbing Mt. Wilson with a Tractor

A TRACTOR built by a western concern has performed the feat of ascending Mt. Wilson, and it is said that this is the first time a tractor has climbed a mountain in southern California. The regular road was followed, and the machine was fitted with rubber-tired wheels, more for the protection of the roadway than anything else.

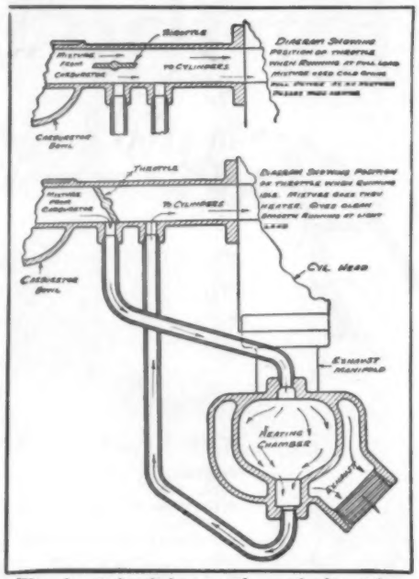
A stock tractor rated at 10-18 horsepower was used and a heavy load was pulled all the way; the trailer and its load weighed 3,063 pounds. The total distance was 3½ miles and the time required for the trip was 2 hours, 41 minutes. The run was made on high gear all the way, and the only stop was one of two minutes duration to allow an automobile to pass in a narrow place. At no time was there any overheating of the engine or trouble of any other sort; this good result was naturally to be expected in a machine built for heavy hauling and continuous hard work. The fuel used was distillate, though the tractor was built to use kerosene; the quantity consumed was a trifle more than five gallons. Only one pint of water was lost in the cooling system.

Non-Electric Starter for Trucks and Tractors

REASONS for applying starters to motor truck and tractor engines are plenty and sound. The engines are usually big and of heavy construction and difficult, in cold weather, to turn over rapidly, for, in addition to the weight of the parts and the normal internal friction, the oil is thick and heavy and, on the whole, the man on the crank is likely to get warm a good deal sooner than the engine. There has apparently been hesitation about installing electric starters in these working automotives, and though here and there it is done it is so seldom that electric starters are rare except, curiously enough, on the smaller trucks where they are least needed.

A starter that does not employ electricity, and which has been installed during the past six or seven years in many motor boats and airplanes, in addition to passenger cars, has recently been developed in a form suitable for heavy truck and tractor engines. The principle of operation is simple and direct. Air at high pressure, mixed with sufficient gasoline or kerosene vapor to form an explosive mixture, is admitted to the cylinders of the engine, each cylinder getting its charge of air just as the piston is about to start downward on the expansion stroke, at which time both intake and exhaust valves are closed. Thus the engine is made to run much as a steam engine is run. After a revolution or two, however, the spark, occurring in the regular way, ignites the mixture and the engine starts and runs and continues to run on its own fuel.

Air is compressed by a small air-pump with a single cylinder which is driven in precisely the same way that a magneto is driven, or a water pump or an electric generator. A hand-operated clutch is used to throw the pump in or out of gear. The air is delivered to a small receiver in which it is stored at a pressure of 250 pounds maximum. The tank has sufficient capacity to start an engine of average size about fifteen times, which will bring the pressure down to about 100 pounds. To restore the pressure to maximum again requires about 4½ minutes pumping; to restore the pressure to maximum after one start—in other words, to put back into the tank the volume of air required for one start—consumes about half a minute. A pressure gage on the dashboard shows the operator when pumping is needed. From the tank a supply leads to a distributer which distributes air to the cylinders precisely as electricity is distributed in the ignition system. The gasoline or kerosene is introduced into the air as it passes from the tank to the engine; none of it goes into the tank, which contains only pure air. The little special carbureter is automatic in operation and always supplies the right quantity regardless of the pressure of the air. The air pump and distributer are mounted as a unit, and together are no larger than a good-sized magneto. The whole of the starting equipment, including pump, distributer, clutch, tank, piping and all smaller parts, weighs about 50 pounds. Lubrication is automatic throughout.



The shunt circuit insures the engine's getting fuel at the right temperature

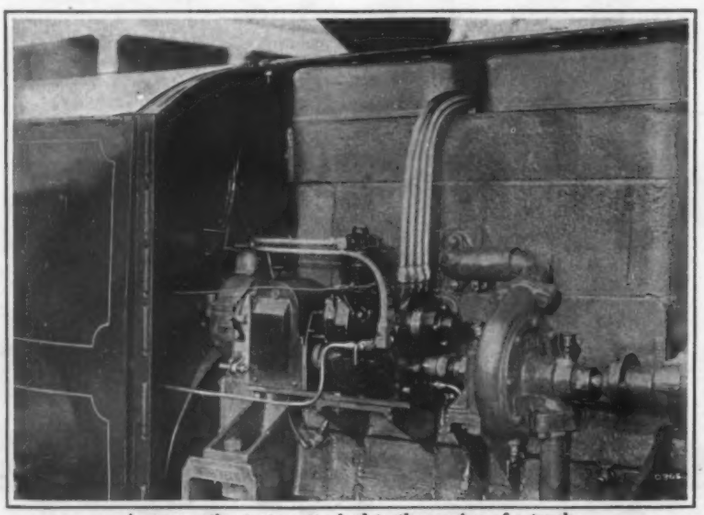
An Adjustable Circuit for Low-Grade Fuels

IT is conceded that with a constant load, kerosene and other cheap fuels would be wholly practicable; but unfortunately, loads are not constant. The ever changing character of the instantaneous demands that the engine is called upon to meet has made the use of kerosene difficult, on account of the lack of volatility. Being a heavier oil than gasoline, and less liable to remain in gaseous form when any inducement is offered it to condense, when an especially heavy load comes on suddenly the kerosene is apt to find that the temperature for the moment is insufficient to keep it in vaporized condition; and this means that the engine is going to stall.

The only remedy is some means of insuring that the mixture shall get the proper amount of heat at all times. At variable load it must get more than when running at uniform full load, in order to afford a factor of safety against the sudden overloads. Of the various suggestions brought forward from time to time to meet this condition, few have been simpler than the one illustrated herewith.

It involves the use of the exhaust to heat the mixture, when extra heat is necessary. But this is not necessary at all times, and when it is not necessary, it would be a disadvantage to have the mixture too hot. So an automatic short-circuiting arrangement is provided, whereby the mixture circulates past the exhaust when it needs the heat from the exhaust, and steers a careful course clear of the exhaust when it does not need that heat.

This is accomplished by means of a shunt operated from the throttle, as the diagram makes clear. Ordinarily the short path from the carburator to the cylinders is open, and the mixture takes it. But when the overload comes, and it is desired that the mixture pass through a heat treatment before reaching the cylinders, the valve is closed from the throttle, and the gas follows the route shown by the arrows in the second part of the diagram. On this circuit lies a heating chamber warmed by the exhaust; so when it is diverted over this path, the mixture gets the desired heating. The manufacturers say that long and severe tests have demonstrated the complete practicability of their device; that with its use, the engine will run on any kind of a mixture, which need not be studied carefully and need not even be uniform; that even when the engine is more or less out of trim the shunt is so adaptable to conditions that good results will be obtained. It is to be understood that the shunt is not designed to get away from the necessity of using gasoline for starting—that problem is left to some future investigator. But we are asked to accept this device as an answer to the objection that low grade fuels in a high grade engine give irregular operation.



A pneumatic starter attached to the engine of a truck

Finishing Crankshafts

A STRIKING indication of the extent to which specialization is carried in the automotive industry is found in the fact that in Detroit, the City of Automobiles, there is a large plant that does nothing whatever but finish crankshafts. It does not make any crankshafts. Rough forgings are received for shafts for airplane, automobile, truck, tractor and stationary engines, and these are turned, ground, polished, drilled for oil passages, threaded and otherwise made completely ready for installation in engines.

All such work is done to the specifications of manufacturers and assemblers. It is to be expected, under the circumstances, that customers will be exceedingly strict in their demands for accurate and correct work and, this being the case, the crankshaft finishing concern has found it necessary to establish a system of gaging, inspecting and checking that is remarkable for its completeness and its working efficiency. A crankshaft that is not perfect cannot be delivered because it is a foregone conclusion that it will be returned as not coming up to specifications, and it will, therefore, represent a dead loss to the finishers—a loss that may be complete, if the shaft is undersize, or partial if the defect can be remedied by further operations.

Bull Gear Drive Housing

PROBABLY the most widely used final drive for tractors is the so-called "bull gear" system, in which large gears mounted on the driving wheels or the rear axle are driven by pinions on the final shaft of the transmission. The system has the drawback, however, that it is difficult to protect from dust, leaving the gear teeth open to destructive wear.

A western inventor has devised an ingenious housing which completely covers the bull gears and pinions and provides favorable operating conditions tending to greatly increase endurance and naturally decrease loss of power. The wheel hub used is of special construction, with a cast steel flange to take the bull gear and other flanges to take the inner ends of the spokes, sufficient metal being provided between the inner spoke flange and the gear flange to take the torsion stresses. A casing, preferably of light but strong sheet steel, is readily placed over the gears, dust washers of felt or other suitable material serving to make tight the joints at the axle on one side and the hub on the other.

POWER

KEEP *power* in mind when you buy a truck, for just one failure to pull through may cause a loss of hundreds of dollars.

Because of their vast *reserve power,* SERVICE Trucks "carry on" regardless of roads, loads or weather.

They keep going when many others quit. One user says:

"You can see why we have such faith in Service Trucks when I tell you on several occasions the _____ trucks were unable to pull through the mud altho carrying ***no load*** *and our Service Truck* ***pulled them out.*** *On the other hand, our Service Truck was able to pull through the same muddy sections with a load on it."*

Get the facts about SERVICE before you buy a truck. The nearest distributor will be pleased to inform you; or, upon request, we will send you catalog, giving full details of the five models—from 1 to 5 tons.

Distributors in All Principal Cities

SERVICE MOTOR TRUCK COMPANY

WABASH, INDIANA

NEW YORK
87-89 West End Ave.

CHICAGO
2615-17 So. Wabash Ave.

94

Service
MOTOR TRUCKS

Reconstruction Department

A Department Devoted to the Improvement of Old and Development of New Lines of Manufacture

The Editor is anxious to help manufacturers who have idle machinery on their hands during this reconstruction period, and who are looking for new articles suitable for them to manufacture. He solicits letters from manufacturers, stating the line of work adapted to their machinery, and from inventors, stating clearly the nature of the devices they have to offer. Inventors are requested to send complete information about their inventions, with working drawings and photographs of models, but models should not be sent as we are not equipped to handle them. The Editor will forward this material to manufacturers who are interested. This service is performed without charge.

Unsafe Safe for Liberty Bonds

To the Reconstruction Editor of the SCIENTIFIC AMERICAN:

I note in your issue of January 11th that a correspondent under the heading, "A Safe for Liberty Bonds" says that the use of a heavy metal securities box "would protect the contents much more thoroughly from fire than do the thin tin boxes on the market." Your correspondent is mistaken in assuming that there would be any difference of practical value between the fire protecting qualities of a heavy uninsulated metal box and those of a thin tin box. We have made many fire tests of safes and similar devices and can say without qualification that neither kind of box would be worth anything from a fire protection viewpoint. It is scarcely probable that your correspondent had in mind metal thicker than in walls of stoves which, every one knows, transmit heat readily and on which no one would think of placing his Liberty bonds. A box which would afford *some* protection (there is no such thing as absolute fire protection) could be made, but it would be bulky and heavy because of the heat insulating or heat absorbing materials necessarily used in its walls and it would be in reality nothing more than a small safe or insulated cabinet.

M. L. CARR.

Underwriters' Laboratories.
Chicago.

Letters from Manufacturers

THE Reconstruction Editor has received a number of letters from manufacturers, calling for inventions which might prove profitable to manufacture. Several of these letters are published herewith. The names of the manufacturers are not given but the letters are numbered, and inventors who reply to them should designate by number to which particular letter their replies are directed.

I

We shall be very glad to have you advise us of any inquiry that you may receive for work in our line.

We have a machine shop equipment consisting of some 265 machines of various types and classes including planers, lathes, millers, shapers, grinders, engraving machines, drill presses, etc.

II

We are a well established corporation located in a New England seaboard city, and engaged in working sheet metals. We are desirous of securing new lines of profitable business. Only propositions promising steady development will be considered. Communications, drawings, data, etc., will be held as strictly confidential.

III

Many good patents are worked out by men who lack facilities for properly developing, manufacturing and selling the results of their inventions.

This letter is to solicit your coöperation in having those of your readers communicate with us, who have inventions that could be made in a factory such as ours.

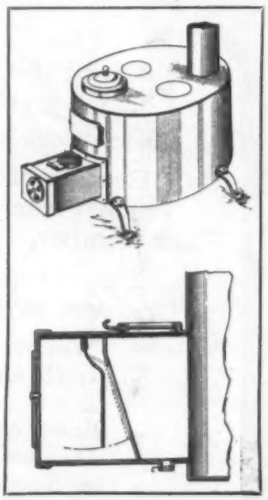
We have a modern plant, completely equipped with machinery, especially selected to produce a variety of articles—both stamped and assembled—in sheet metals up to 10-gage in thickness; we also maintain a retinning plant and baked enamel finishing plant where we apply plain enamels, reproductions of beautiful wood grainings or ornamental metal finishes.

Our staff of engineers has had many years experience in sheet metals as applied to a variety of industries; while our selling organization blankets the entire country.

If any of your readers are seeking a manufacturing and sales connection, we shall be pleased to have them communicate with us with a view of taking under consideration practical articles of sheet metal, or largely of sheet metal, for which they need a manufacturing and selling organization.

IV

Inventors desirous of making a connection with a concern for the manufacture and commercial development of their articles are invited to correspond with us on the subject.



Heat regulating attachment for stoves

Our present line consists of lathe and drill chucks, boiler and radiator chaplets and nipples, electrical outlet boxes, locknuts, bushings, ferrules, metal stampings and drawings. For the information of those not conversant with the machinery necessary to turn out the above products in large quantities, we would state that our mechanical equipment consists of the following:

Lathes, drill presses, milling machines, grinders, etc. Batteries of blanking, punching and drawing presses, annealing and enameling ovens, tapping machines, rivet machines, tumblers. In addition we are operating large electro-galvanizing and copper-plating outfits. To sum up, we can make any article of any metal whose construction involves stampings or drawings, not heavier than 12-gage material.

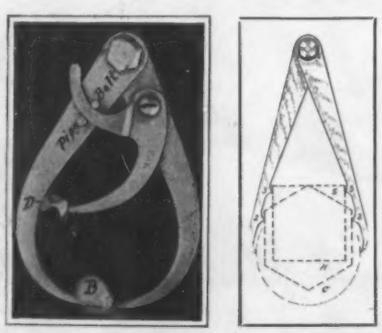
A large part of our plant is now idle on account of the completion of government contracts and we desire to take on some patented article of merit, whose construction calls for an equipment of our type. We might add, however, that we are prepared to spend whatever sum necessary to buy additional or different equipment, should the invention possess commercial possibilities which would warrant it.

This company has been doing business for over a quarter of a century and we believe the reputation we have built up will be a distinct asset to any proposition we might go into.

We are in a position to go ahead immediately; correspondence on the subject will receive most prompt consideration.

Converting the automobile into a power-driven sleigh

Shoe stretcher in closed and open positions showing details of construction



Two calipers that save time in the workshop

Letters from Inventors

THE Editor has received a great many letters from inventors, covering a wide range, and wherever possible these have been referred to manufacturers who might be interested in them. Some devices do not seem to fit any of the requirements so far specified. A few of these are published herewith in the hope that they may appeal to some manufacturer who has not yet written to the Reconstruction Editor:

Heat-Regulating Attachment for Stoves

To overcome the disadvantage of having to turn the draft dampers on and off frequently, an inventor has devised a simple heat-regulating attachment, consisiting of a sheet metal device in which is placed a damper that is normally held open by gravity. As the stove grows hot, the draft passing through the device is increased and this tends to swing the damper into a closed position, as indicated by dotted lines in the sectional view.

Snow Attachment for Automobiles

In order to make an automobile of service in deep snow, an inventor has provided a set of runners adapted to carry the weight of the machine. These runners are flexible and can be flexed by the ordinary steering wheel to guide the machine. To propel the machine, the tires of the rear wheels are removed and in their place steel bands are made fast, these bands being provided with hooked-projecting members that grip the snow or ice. These hooks are flexible so that they will pass under the wheel as it revolves.

Shoe Stretcher

The accompanying illustrations of a new form of shoe stretcher are self-explanatory. The device consists of a form, preferably made of sheet metal, which is composed of hinged members that may be spread apart by the turning of a handle to stretch the shoe. The device is arranged to apply pressure at the toe, heel, instep, or any other desired portion of the shoe.

Improved Calipers

Two forms of calipers are pictured herewith. The half-tone illustration shows an outside caliper equipped with an attachment which gives the size of drill to use for a given size of bolt or pipe. This enables one to select at once the right size of drill. If desired, the attachment can be swung to one side on opening the caliper, so that the instrument can be used for ordinary work. The line drawing shows a caliper which gives the minimum diameter of circular stock from which square or hexagon pieces can be made without unnecessary waste of material. The dotted lines show the application of the caliper.

I AM AN AMERICAN!

(On December 7, 1918, the Alien Property Custodian of the United States sold the entire holdings of the Bosch Magneto Company which have been taken over by an American Manufacturing Corporation. The Personnel was submitted to the Custodian before sale)

THE history of the development of the Internal Combustion Motor is the history of Bosch Ignition. The Bosch is now an American Institution which will necessarily maintain the same scrupulous care in the purchase of materials, the same exact precision which has marked its every manufacturing process and the same exhaustive laboratory and field experimentation which has kept Bosch Ignition in step, without interruption, stride for stride with the motor progress of the world.

There has never been any manufactured article whose reputation for satisfactory performance has been better than the Bosch.

After America entered the war, thousands of Bosch Magnetos—85% of the entire output of the great Bosch works at Springfield—went into vital war service on army trucks, tractors, airplanes, motorcycles, etc.

Bosch now is new only in ownership—it comprises the same active heads that administered the company under the Alien Property Custodian during the war. The Bosch Organization, which from the first has dominated the field of Ignition, enters upon a new era of service to American Industry. Motor triumphs of the future, as of the past, will be built on the firm foundation of Bosch Ignition.

AMERICAN BOSCH MAGNETO CORPORATION

Main Offices and Works—SPRINGFIELD, MASS. Branches—NEW YORK, CHICAGO, DETROIT, SAN FRANCISCO Service Stations in 200 cities

AMERICA'S SUPREME IGNITION SYSTEM

MOTOR TRUCKS—TRACTORS—AIRPLANES—MOTOR CARS—MOTOR BOATS—MOTORCYCLES—GAS ENGINES—Etc.

RECENTLY PATENTED INVENTIONS

Pertaining to Apparel

HOSE SUPPORTER.—C. M. CORLEW, E. SCUDDER and J. CARLSTON, Sioux Falls, S. D. One of the principal objects of the invention is to provide a garter adapted for use in connection with knee length underwear. A further object is to provide an elastic hose supporter designed to connect the hose to the undergarment in such manner as to be readily and quickly attached and detached, and to hold the underwear and hose in their proper relative position without encircling the leg or otherwise causing injurious pressure thereon.

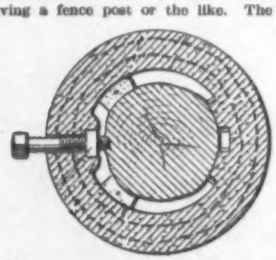
Electrical Devices

ELECTRICALLY HEATED CLOTHING.—A. A. LEMERCIER, Paris, France. This invention has for its special object a method of making electrically-heated clothing characterized by the fact that the fabric supporting the conducting wires forming the resistence is arranged on the bias in the figures of the glove, and that the heating wires are fixed zig zag on this fabric parallel to the warp and welt threads of the latter. By this arrangement, when a pull is exerted on the supporting fabric, the heating wires follow all the movements of the warp and welt threads and are not liable to break.

PERMUTATION ELECTRIC SWITCH.—M. E. MEAKILL, 23 Van Reypen St., Jersey City, N. J. This invention relates to electric switches or circuit breakers and has particular reference to devices of this character that are intended to provide a convenient and reliable means whereby an authorized person only may close the circuit and so derivs the advantage from the strength of the electric current passing through the circuit.

Of Interest to Farmers

FENCE POST BASE.—W. T. BENNETT, JR., Box 54, Cope, Colo. The invention relates to tubular reinforced concrete bases or sockets for receiving a fence post or the like. The prime



A HORIZONTAL SECTION OF THE BASE

object is to provide a post base of such form as to drain and be afforded ventilation whereby to prevent accumulation of moisture that would result in the rotting of the post. A further object is to provide means, in the form of a set screw and cement wedges, whereby to firmly secure the post in the base, and provide air space around it.

Of General Interest

FILTER.—G. CAEN, SR., San Antonio, Texas. The invention has for its object to provide a device especialy adapted for removing impurities from gasolene and oil, to fit the gasoline or oil for reuse. The filter comprises a casing composed of upper and lower sections, the upper section fitting within the lower, and having nipples depending into the lower section, the filter units having discharge pipes extending through the nipples, and a casing seated in the upper section having a perforated bottom.

SAFETY ATTACHMENT FOR BREASTPINS AND THE LIKE.—P. E. JOHNSON, Abercrombie, N. D. This invention relates particularly to breastpins and the like, the object being the provision of simple and positively acting means in securing pins of articles of this nature, whereby to act as a guard and prevent accidental dis-

A PERSPECTIVE VIEW SHOWING THE INVENTION COMPLETE

placement and loss. More particularly the invention aims at a guard for pins which will be brought into action automatically when the pin is attached, but which will require disengagement before the pin can be removed.

Hardware and Tools

VISE.—C. M. HERBERT, 104 Morse Ave., Rutherford, N. J. The invention has for an object the provision of a vise which may be used for gripping lightly objects of different shapes, and then by a manipulation of a lever tightening the grip. Another object is to provide a vise which is designed to grip round objects especially and particularly a cable of comparatively soft wires so as to hold the same during a splicing or other operation.

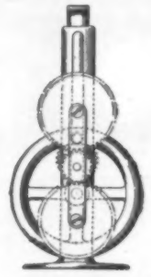
JACK HANDLE.—A. F. WAGNER, Gibralter Jack Co., 1902 Broadway, New York, N. Y. This invention relates to handles for lifting jacks and has for an object the provision of a construction which will properly actuate the jack, but which may be quickly collapsed into a comparatively small space. Another object is to provide a jointed handle with means for locking the same in an elongated position when in use, the parts may be folded when desired, and stored in a tool box or other receptacle.

Heating and Lighting

DRAFT GAGE.—R. E. THOMPSON, Deming, N. M. The object of this invention is to provide a gage especially adapted for use with a furnace or other heater, for indicating the pressure in the combustion chamber and in the stack, to permit the fire to be regulated to maintain a given reading on the scale of the gage.

Machines and Mechanical Devices

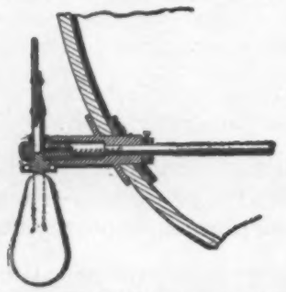
MECHANICAL MOVEMENT.—W. J. PAYNE, Panther Burn, Miss. This invention relates to mechanical movements particularly adaptable for obtaining a reciprocating motion. An object of the invention is to obtain a simple



AN ELEVATION OF JACK PROVIDED WITH INVENTION

and inexpensive movement which is particularly adapted to jacks. In cases where the mechanical movement is utilized for pumping purposes in place of a hand wheel, such as would be provided for a jack, a pulley or other similar element may be substituted.

BOAT PROPELLER.—J. A. FITZPATRICK, 111 Stewart Ave., Carrick Borough, Pittsburgh, Pa. The invention relates to propellers of that type in which blades are attached to rotating shafts projecting laterally from the sides of a boat and below the water line. The device is so ar-

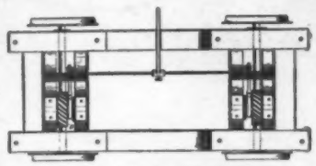


A SECTION TRANSVERSELY THROUGH THE VESSEL

ranged that the blade delivering the force of the stroke will be set at right angles with the line along which it is being forced, while the upper blade will be set parallel with that line and thus offer a small amount of resistance as it passes through the water. The propellers may be used in any desired number, and driven in a forward or in a reverse direction.

FILTERING DEVICE.—E. E. HOWSON, Box 682, Tonapah, Nev. This invention relates to a filtering device in which any pulverized solid in suspension may be filtered for extracting certain parts thereof, as for instance ore containing precious metal. An object is to provide a rotatable distributing construction and filtering means associated therewith, designed to be supplied with the matter suspension to be filtered and then operated in a plurality of different ways in succession so as to extract part of the solids suspended and discharge the remaining solids at a given time.

SAWMILL CARRIAGE.—S. FORSYTHE, Davis, W. Va. The object of this invention is to provide mechanism in connection with sawmill carriages for moving the carriage laterally toward and from the saw as it moves longitudinally.



A TOP PLAN VIEW OF THE MECHANISM

In operation, the carriage bearing the log is moved toward the saw, the engagement of worm wheels will constrain the carriage body to move laterally toward the saw, and will hold the carriage in such position with respect to the saw, until the saw has passed through the log.

PROCESS OF EXTRACTING SOLIDS.—E. E. HOWSON, Box 682, Tonapah, Nev. The invention relates to a method of filtering, whereby solids are extracted from a suspending liquid in a manner to provide mechanically a continuity of operation from the beginning to the end. An object is to provide a filtering process with successive steps arranged in such a manner as to permit of a continuous operation while portions of a solid and suspending liquid will be passing through different and successive steps.

Medical Devices

DENTAL FLOSS.—G. H. and E. D. GUDEBROD, address, Gudebrod Bros. Silk Co., 255 Fifth Ave., New York, N. Y. The object of this invention is to provide a dental floss which is exceedingly strong and adapted to be passed between the teeth or drawn over the surface for the purpose of effectively removing extraneous matter on cleaning the teeth. Another object is to provide a floss with a polishing powder therein to act as a file to facilitate the removal of extraneous matter and the polishing of the teeth.

Musical Devices

AUTOMATIC STOP FOR PHONOGRAPHS.—G. H. TAGGART, 200 Central Park, S., New York, N. Y. Among other objects the invention has in view the provision of simple, reliable and inconspicuous mechanism, that requires no adjustment or attention on the part of the operator after it is applied to the machine, but which will automatically stop the motor when the end of the record is reached, irrespective of the size of the standard disk or length of the record, and which is not subject to premature stoppage from any cause.

Prime Movers and Their Accessories

PISTON CONNECTION.—E. FUCHS, JR., care of Field Artillery, A. E. F., France, care of Postmaster, New York. This invention while adapted for use in connecting drive rods generally with the elements to be driven, is more particularly intended for use as a means of connecting the piston and piston rod of an internal combustion engine, whereby to promote flexibility and an even distribution of pressure as well as to enable the piston to properly aline itself with the direction of thrust and effect an even wear, on the piston, piston rings and cylinder.

DEVICE FOR CRANKING INTERNAL COMBUSTION ENGINES.—C. M. RHODES, Steubenville, Ohio. An object of the invention is to provide a device by means of which injury from back fire may be avoided, due to the fact that the clutch members are thrown out of engagement. A further object is to provide a device with ball bearings which insure disengagement of the clutch members. The device consists of few parts and is therefore, not easily liable to get out of order.

Railways and Their Accessories

RAILROAD RAIL JOINT.—E. N. WALLACE, Kokomo, Ind. This invention is an interlocking joint or connection between the ends of railroad rails whereby fish-plates and screw-bolts are dispensed with, greater safety in travel is obtained, and economy in time and material is effected. The rail joint comprises rail ends provided respectively with a hook and socket.

METALLIC RAILROAD TIE.—C. RUGGABER, Savannah, Ga. The object of the invention is to provide a tie having means for rigidly connecting the rails to the tie. The device provides a tie having transverse grooves on its upper surface for the seating of the rails, and of a width and depth to receive the base flanges of the rails, said tie having openings at each side of the groove for receiving locks to lock the rails to the tie, locking devices being provided for the inside of each rail, for preventing inward or upward movement.

Pertaining to Recreation

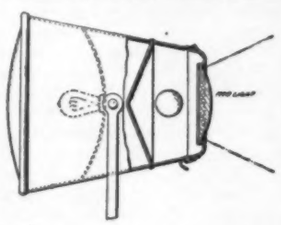
JOINTED TOY FIGURE.—E. J. READ, 249 W. Passaic Ave., Rutherford, N. J. The object of the invention is to provide a jointed toy figure arranged to permit of readily and conveniently changing the position of the movable members to represent the figure in various artistic, grotesque or other attitudes or poses. Another object is to permit the user to readily assemble the parts and to hold the same in the adjusted position without special fastening devices.

TOY.—L. R. POSCHADEL, 155 Garfield Ave., Milwaukee, Wis. An object of this invention is what might be termed a shooting toy as well as a sounding toy whereby a double interest is provided. Another object is the provision of means in the toy whereby a projectile is projected by spring power, but released by the hand either by operating on the projectile direct or through the movable rod.

SWING.—H. M. WALKER, Hawkinsville, Ga. The invention has for its object to provide a swinging device wherein an arc-shaped track is provided, upon which vehicles are adapted to run down one side by gravity and to be propelled up the other side by momentum assisted by the movement of the occupants of the vehicle.

Pertaining to Vehicles

SIGNAL LAMP.—C. B. SHERWOOD, Box 284, Cornwall-on-the-Hudson, N. Y. The object of the invention is to provide means in connection with the lamp or lamps of motor vehicles, for



A SIDE VIEW OF THE LAMP WITH PARTS IN SECTION

signaling rearwardly the intention of the driver to stop or turn, wherein an auxiliary lamp is mounted at the rear of the usual lamp and adapted to be ignited at will.

ATTACHMENT FOR AUTOMOBILES.—L. H. ANDERSON, Carroll, Iowa. The invention has for its object to provide mechanism in connection with the windows of automobile tops, for holding the transparent sheet firmly in place, and by means of which the transparent sheet may be easily attached to the frame or detached therefrom, and wherein the frame is rigid to prevent bending of the transparent sheet.

VEHICLE TIRE.—M. SCROCCO, 10 Woodcourt, Tarrytown, N. Y. This invention relates to a vehicle tire of that type embodying a plurality of spring members within a rubber or other case in order to take the place of the ordinary pneumatic tube, so as to do away with punctures, blowouts and other objectionable features. A more specific object is to provide a spring device with the desired resiliency to insure easy and smooth running of the vehicle.

SPRING FIRE FOR VEHICLE WHEELS.—C. E. DUPELL, 10 Stone Ave., Brooklyn, N. Y. An object of the invention is to provide a simple and inexpensive tire of the resilient type in which the filler is in the shape of a sectional annulus flattened on the inner surface to provide the necessary clearance for permitting the shoe to yield under load, the clearing space also serving for the accommodation of the springs which tend to expand the filler.

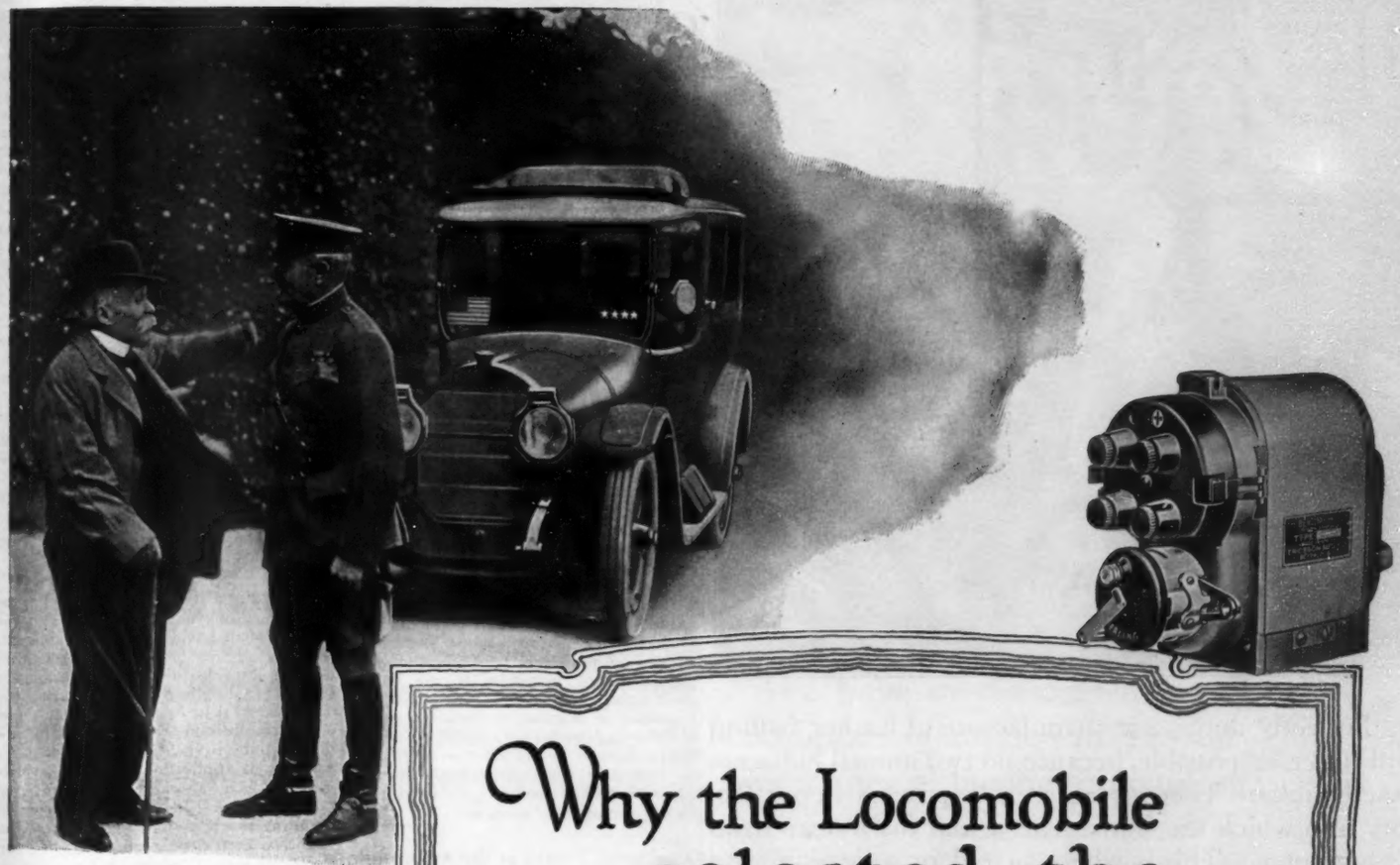
ELEVATING TRUCK.—J. WILLER, 128 Chambers St., New York, N. Y. This invention has for its object the provision of a construction which may be quickly and easily shifted from one position to the other with or without the load. A further object is the provision of elevating trucks wherein the lifting planes may be arranged either on the movable section or stationary section, and locked in both the elevated or depressed position.

Designs

DESIGN FOR A FABRIC.—A. WILCOCK, address R. Carrillo & Co., 12 W. 37th St., New York, N. Y. The inventor has obtained patents on two designs.

DESIGN FOR A DOLL.—LELIA M. FELLOW, 216 Grosse Building, Los Angeles, Cal.

DESIGN FOR A FLAG, PENNANT, SIGN, EMBLEM, OR OTHER ARTICLE OF A SIMILAR NATURE.—J. D. GIUFFRE, 107 Rapelyea St., Brooklyn, N. Y.



When Premier Clemenceau and General Pershing Met at Versailles

Above is from photo by Signal Corps U. S. A.—Copyright by Committee on Public Information.

On the right is General Pershing's Locomobile.

On practically all products of the Locomobile Company—including Riker trucks—the Berling Magneto helps insure dependable ignition.

Why the Locomobile selected the Berling Magneto

THE LOCOMOBILE COMPANY adopted Berling equipment because, under actual test for a year, the Berling was proved to possess what the Locomobile Company looks for in a magneto:

First: Irreproachable Material
Second: Uniform and High Grade Workmanship
Third: Sound Design and Absolute Dependability

THE BERLING MAGNETO was adopted simply because it was found to have these qualities to a pre-eminent degree.

ERICSSON MFG. CO., BUFFALO, N. Y.

Berling Magneto

WORTH MORE DOES MORE

Perfectly automatic manufacture of leather belting will never be possible, because no two animal hides are exactly alike. There is scarcely a process in our factory into which the human head and the human hand do not enter. This is where an old organization with traditions, long experience and expert workmen count.

Jewell Belting

is made in various forms for every manufacturing purpose. If you have a troublesome belting problem, one of our men can help you solve it, and there is a Jewell belt to keep it solved.

We have dealers at convenient points to supply your needs promptly, and correspondence to this end is invited.

"It is less costly to buy a good belt than to suffer from a poor one."

Jewell Belting Co.
Hartford, Connecticut

Chicago Branch
2837 So. La Salle St.

New York Office
2 Rector St.

The Current Supplement

ONE of the interesting problems before the conference at Paris is the disposition of the German colonial possessions. Some of these were islands in the Pacific, and with an understanding of German plans for world domination has come an appreciation of the strategic importance of these islands, as well as their commercial value. This knowledge has aroused considerable attention in England because of the bearing of the matter on the very important interests of that nation in the region in question. A discussion of the problems involved, from a British point of view, will be found in an article on *The Islands of the Pacific* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2250, for February 15th, which considers their present state and future importance. This is a matter of importance to our country as well as to England both from a commercial and a political standpoint. It seems strange that there should be any part of our country that is not perfectly well known to all of our people by this time, but such is the fact. *The Story of Canyon de Chelly* tells of one such locality of considerable attraction both for the archaeologist and the tourist, and is accompanied by a number of attractive photographs. In *How Plants and Animals Utilize Color* a distinguished French naturalist discusses various pigments that protect living matter against radiations. *Fishing by Machinery* tells how the great salmon fishing industries of the Pacific coast gather their harvest from the sea, and a number of illustrations show the nature of the apparatus employed. The illustrated paper on *The Detection of "Ghosts" in Prisms* is concluded. *Notes on Kite Flying* considers the question in relation to meteorological observations.

Absence of Freaks at the Automobile Show

IMPROVISED as the recent Automobile Show may have been, it was one of the most successful ever held. The exhibits were numerous and varied, although the novelties and oddities which generally add color to such an exposition were noticeably lacking. Considered as a whole, the models shown followed closely the lines of a year or more ago; for it is quite obvious that during the past 18 months the automobile designers and manufacturers, with their whole energies directed toward producing war materials, have had little time to devote to untried changes in motor car construction. So they have generally made the present models follow the tried and proved lines of a year ago, with here and there a slight modification.

In fact, the outstanding feature of this season's New York Automobile Show is the absolute absence of freakish inventions. As a result of our recent war activities, the irrepressible discoverers of mechanical fallacies have been more or less effectively suppressed. In other words, the pressure of war work has made us a very practical people during the past months of such activity, and we have not had time for anything which was not practical on its very face. Hence freak cars and freak attachments are totally missing in this season's offerings; and the buyer of any of the cars now offered is assured a machine that will perform its work efficiently and satisfactory, for there is nothing about it in the nature of an innovation or experiment. All cars shown at the New York Show were at least one year old in design; and 12 months is more than ample time to bring out the concealed flaws of any machine in constant use.

In the lull brought about by war work, automobile designers have perfected the small details of their respective cars. Also, new and beautiful bodies have been introduced. Most of the so-called new models are in the nature of a rearrangement of old and tried features.

So far as the passenger car is concerned, the war has taught the automobile designer but little. Even the concentrated efforts on the Liberty and other aviation engines have developed little of value for the passenger car, for the reason that the aeronautical power plant and the automobile engine are **two** entirely different machines, despite their similar appearance. One is a constant speed engine while the other is a variable speed engine. The conditions of operation are totally different.

However, if the passenger car has not gained much by the war experience of its designers and builders, the motor truck has gained—and gained a lot. The vast demands of the American Army transport service created tens of thousands of motor trucks. In meeting the rigid requirements of military service, and in the standardization of numerous features of design, the motor truck manufacturers have gained invaluable experience which is already reflected in many of the season's offerings shown during the second half of the New York Show.

Some Non-Poisonous Gases and Their Uses

(Continued from page 140)

as 0.06952 and helium as 0.131. It gives satisfactory bouyancy, therefore, and now that we shall have helium available at a commercial price we may expect many uses for it to be discovered, although a supply for dirigibles is not yet in sight. Then should it be found through this work of securing helium that a method for producing pure oxygen cheaply enough for commercial application has been evolved we will have another reagent of great potentialities. There are some reactions requiring the heat of the electric arc that might be carried out using oxygen where electricity is not available or it might prove better technical practice. It is not known just what would be the result if the temperature of the blast furnace could be raised a few degrees by the use of oxygen, but it might well be that a beneficial revision of methods would take place.

Uses of Oxygen

In the gas industry oxygen would make it possible to use inferior fuel in producers and furnaces by enriching the air, and it is often used to melt through stoppages in blast furnaces. Oxygen is an aid to varnish manufacturers while its use with acetylene is becoming as widespread as with hydrogen for autogenous welding and cutting because of the higher temperature attainable, and hence the increased speed of working. To cut a manhole in an average boiler takes the effort of two men for seven to eight hours, but with gas the same opening can be made in from seven to eight minutes. In salvage and repairs autogenous cutting has become indispensable. It was oxy-acetylene that enabled the recent molasses tank wreckage in Boston to be quickly removed and this intensely hot flame has a place in every wrecker's equipment. Its use in medicine needs no comment.

Oxygen was formerly derived from barium peroxide by the Brin process. This consisted of heating the oxide in air to about 500°C., at which point oxygen is rapidly taken up, forming the peroxide. The heating is continued until approximately 1,000° C., is reached when the added oxygen is liberated and the oxide formed. An improvement is based on the fact that if air is admitted under pressure barium oxide becomes the peroxide at 700° C. and by reversing the pumps, thus creating a partial vacuum, this oxygen may be taken off without a change in temperature taking place. There is, therefore, a distinct gain in economy through saving in fuel. There are many chemical reactions yielding oxygen, such as when water is added to a mixture of 39 parts of sodium peroxide and 100 parts of bleaching

(Continued on page 156)

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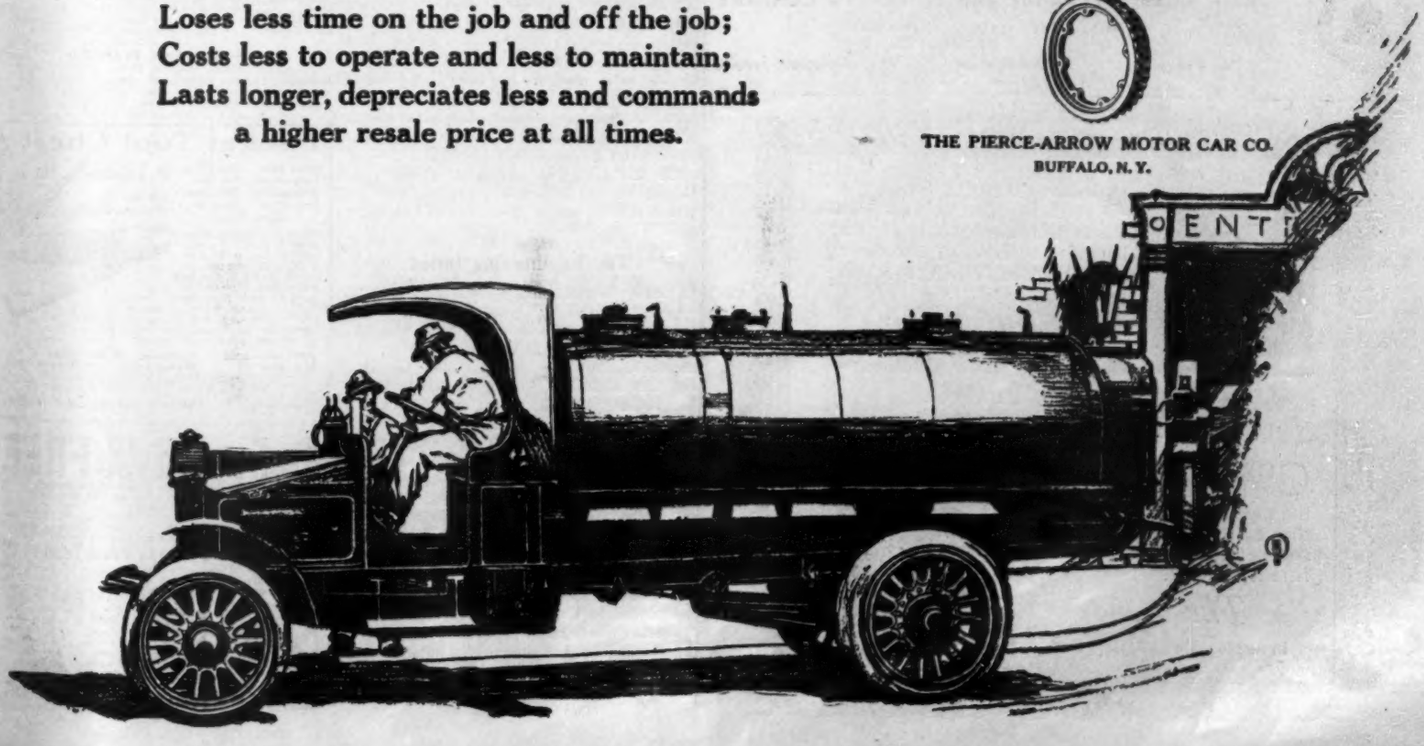

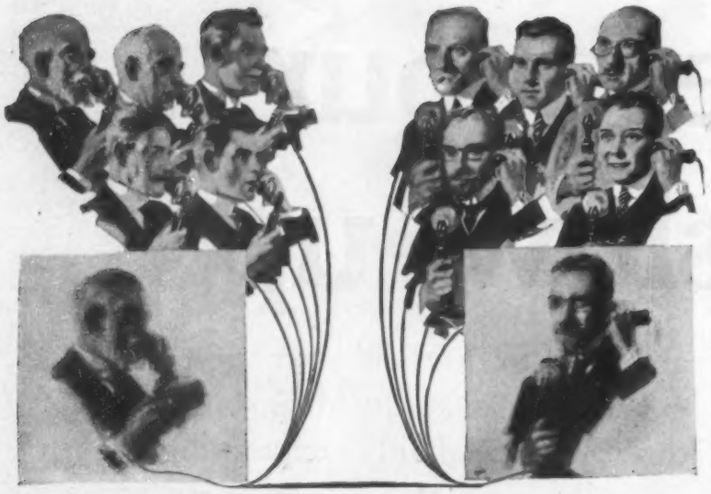

Multiplexing the Telephone

Marvel has followed marvel since Alexander Graham Bell invented his first simple telephone, the forerunner of the millions in use today.

In these last four decades thousands of Bell engineers have developed a system of telephonic communication, so highly perfected, that the same crude instrument which at the beginning could hardly carry speech from one room to another can now actually be heard across the continent. This is because of the many inventions and discoveries which have been applied to intervening switchboard, circuits and other transmitting mechanism.

The vision of the engineers has foreseen requirements for increased communication, and step by step the structure of the art has been advanced—each advance utilizing all previous accomplishments.

No one step in advance, since the original invention, is of greater importance, perhaps, than that which has provided the multiplex system by which five telephone conversations are carried on today simultaneously over one toll line circuit, or by which forty telegraphic messages can be sent over the one pair of wires. As in a composite photograph the pictures are combined, so the several voice waves mingle on the circuit to be again separated for their various destinations.

By this wonderful development the Bell System obtains for the public a multiplied usefulness from its long distance plant and can more speedily and completely meet the needs of a nation of telephone users.

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The Lenox

In fashionable Back Bay, Boston

Some Non-Poisonous Gases and Their Uses

(Continued from page 154)

powder having 33.35 per cent available chlorine; and these compounds are marketed for the production of small quantities of the gas.

Processes of Liquefying Air

Oxygen for commercial purposes is usually obtained by the electrolytic or the liquid air route. It may be had as a by-product from certain electrolytic cells such as those making hydrogen as the primary product or, where power is cheap, electrolytic methods may be used with oxygen as the first consideration. Liquid air, which was such a favorite for lecture experiments a short time ago, has become of commercial importance, due to progress in liquefaction practice, for the production of pure gases. It may also be used to a limited extent for the attainment of very low temperatures especially in scientific experiments often with a view to securing extreme dryness by freezing out the last traces of moisture.

In the Linde process air is first compressed to 40 and then to 200 atmospheres after which impurities and moisture are removed. It is then expanded down to 40 atmospheres, led through a heat interchanger and, thus cooled, is returned to the compressor, where 200 atmospheres pressure is again secured. This process is repeated until finally some of the air reaches a temperature at which under the pressure it becomes a liquid. This liquid is allowed to expand in a vessel at atmospheric pressure causing great evaporation of very cold air. This is passed into the heat interchanger to cool the compressed air and about ninety minutes after the apparatus is started liquid air in excess of the requirements of the process may be drawn off. Ammonia compressors are used to cool the air in commercial plants and calcium chloride is a common drying agent.

The Claude process employs lower pressures, while a system of heat interchangers and an expansion engine enables the production of liquid air in a short time. Low costs are thus realized but still greater economies in the use of power are claimed for the new Norton process.

With liquid air as the starting point it would seem that the separation of gases should be as simple as any other fractional distillation. Elaborate rectification systems have been necessary, however, in order to secure satisfactory yields and purity. The boiling point of oxygen at atmospheric pressure is —182.7° C. and of nitrogen —195.5° C. Utilising this difference in boiling points modern columns have produced oxygen of 99 per cent purity and nitrogen 99.9 per cent.

Of the liquefied industrial gases mentioned all are colorless excepting oxygen which is blue, ozone dark blue and air light blue.

The Engineering Index

THIS compilation, published for 25 years in and by the *Engineering Magazine* and its successor, *Industrial Management*, and universally accepted as the standard in its class, has been acquired by the American Society of Mechanical Engineers, and will hereafter be published by the Society. As heretofore, it will be regularly issued in three forms, as a part of the Journal of the Society, as a separate sheet for slipping purposes, and as an annual volume for the permanent recording of all the items of the year.

The Index has been well cared for by its commercial proprietors; but the development of their interests in special fields has made it seem desirable that the Index be placed in the hands of an organisation covering the broader aspects of engineering. It goes without saying that a better choice could hardly have been made. Through the facilities afforded by the magnificent

(Continued on page 158)

LEGAL NOTICES

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SCIENTIFIC AMERICAN
contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

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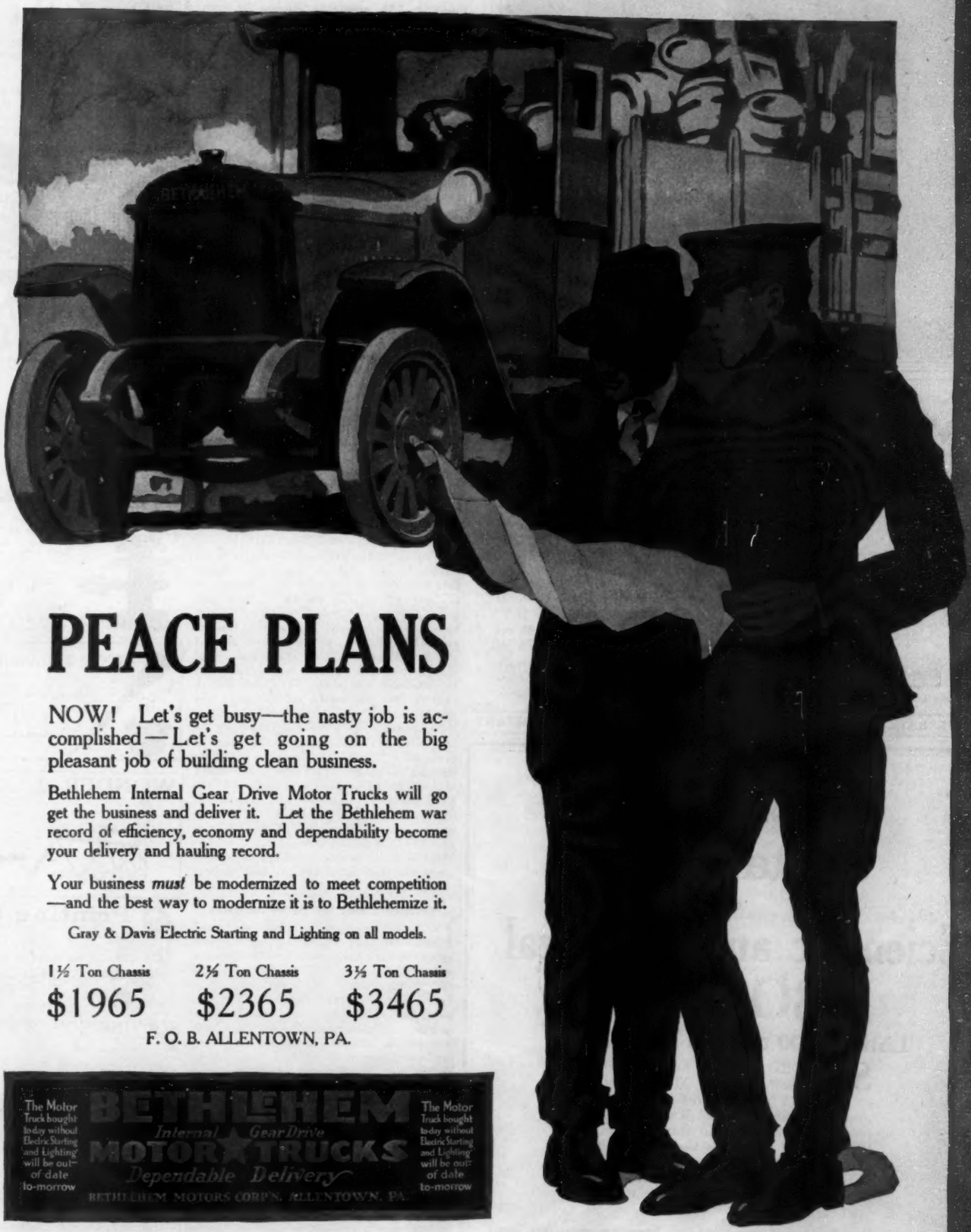

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The Engineering Index

(Continued from page 156)

library of the Engineering Societies, which regularly receives 1,100 periodicals from all over the world, the Society has unlimited possibilities in the direction of indexing. An adequate scheme of subhead classification has already been worked out, on a scale which makes it plain that the Index in its new dress will be as comprehensive as could be wished by the most cosmopolitan or the most highly specialized of engineers.

This undertaking affords but one more demonstration of the inherent soundness of the project which, several years ago, housed all our leading engineering organizations in the one Engineering Societies Building; for the magnificent library which alone makes it possible to undertake an index on such a scale is, in its turn, made a possibility by the pooling of the resources of all the associated bodies.

Electrolysis in Reinforced Concrete

THE suggestion is made by a French scientist in *L'Année Scientifique* (Paris) that the deterioration of reinforced concrete may be caused by spontaneous electrolysis. The theory is that dampness and chemical impurities in the water employed in the manufacture of the concrete give rise to a continuous flow of local currents which slowly corrode the metal, and, little by little, cover it with a layer of oxide. The metal framework thus increases gradually in volume, so as finally to exert sufficient pressure to cause cracking and bursting. That this pressure may be very formidable is proved by the following experiment. In a steel cylinder having an inside diameter of 38 millimeters a steel rod 23 millimeters in diameter is inserted, the free space then being filled with cement. The inside rod is then connected with an electric circuit and the apparatus placed in a tub of water. Under the influence of the current the rod will be oxidized and correspondingly increased in size. It will thus exert a pressure upon the cement surrounding it which will be transmitted to the cylinder; under the influence of this pressure the cylinder will expand and the measurement of this expansion proves that the pressure exerted in a comparatively short time is equal to 350 kilograms (770 pounds). It is obvious that even the best cement could hardly resist such a pressure. Another experiment, even more striking, supports this view. A column of cement 30 centimeters high and 150 millimeters in diameter and having an iron core running from one end to the other was plunged into water. A 50-volt current was then passed through the iron core, which acted as the anode; in less than three hours the column of cement had entirely collapsed.

Tungsten and the Steel Industry

IN the steel industry a number of metals are now used which, not many years ago, were little known except to students of metallurgy. Some of these unfamiliar metals have come into great prominence during the war, both on account of their being essential to the production of armaments and munitions of war and also because of the serious problems which arose connected with their supply. Of such metals, tungsten is one of the most important; its principal application being in the manufacture of steels having the special qualities of hardness and toughness that are required for high-speed machine tools. These steels also possess the valuable property of retaining their hardness, and hence their cutting power, even when heated to redness by the friction of the work which is being performed.

The sources of supply of tungsten ores and the production of the metal ore, therefore, are of interest not only to those concerned in the great metal and engineering industries, but also to those engaged in mining enterprises, and again to those occupied in the export of metal goods whose successful and economical future

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Tungsten sprang into prominence early in the war because of the urgent requirements for the steel industry for high-speed machine tools, and because it furnished a typical example of a "key industry" monopolized before the war by Germany. The story is now fairly well known. The refining of tungsten had been carried on almost exclusively in Germany. From the moment of the outbreak of war the establishment of a tungsten refinery in the United Kingdom was of the utmost importance in view of the needs of the factories engaged in the production of arms and munitions. By coöperation among a number of the largest steel manufacturers in Great Britain this was quickly accomplished, and regulations were made by the Government for controlling the export of ores of tungsten from British territories.

Burma was until 1916 the largest producer of wolfram, the principal ore of tungsten. Though possessing the richest tungsten-ore deposits in the world, Burma has been handicapped by crude methods of mining and treatment of the ore and by primitive means of transportation. Great improvements in those matters, however, have been made recently.

The keen demand for tungsten led to a remarkable display of energy in the United States in prospecting for new occurrences of ore and in developing existing deposits in this country. The result is that the United States has outstripped Burma in ore production during the last two years, and has also become a considerable exporter of tungsten metal and ferro-tungsten alloy to steel-manufacturing countries. Large increases in ore output have also taken place in Japan, in Portugal (where the chief producer is a British company), and in Argentina, Bolivia and Peru. Stimulated by high prices, mining of these ores in the three last-mentioned countries has rapidly extended during the past three years, the output being shipped chiefly to the United States.

Australia is second in importance among British territories producing tungsten ores. In Queensland many of the principal mines have quite recently been acquired by one of the largest of the concerns which have established tungsten-reduction plants in Great Britain since the war, and the event appears to promise a new era of progress for this branch of mining in Queensland. Wolfram is mined in New South Wales and Victoria, while important quantities of scheelite, another ore of tungsten, are obtained in New Zealand and in Tasmania. Wolfram is also obtained as a by-product of the Cornish tin industry, and has received special attention during the last four years. Canada has become a producer, chiefly of scheelite, mined in Halifax County, Nova Scotia, and deposits are also known in Rhodesia.

It is difficult to foresee the future of tungsten, and we do not propose to make any prediction, but it is worth while to examine the considerations which would lead one to form an opinion. It would be optimistic to expect a continuance of the eager demand and handsome prices realized at times during the past four years. If a general commercial depression and a fall in the world's demand for steel were to take place, tungsten would suffer as would many other commodities. On the other hand, activity in the world's steel trade such as we expect to witness in the future for some time to come should support the position of tungsten. Its popularity among steel makers as a steel hardener would seem to be established for the present. The possibility may also be borne in mind that the results of scientific research, which has been continuously conducted during the war, may lead to new uses for the metal. Tungsten proved to be a dominating factor in military power as soon as it was recognized that modern war must be waged by shells by the million and guns by the thousand. Its industrial power in times of peace may prove equally great.

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Among our many standard lines of Superior Machinists' Tools, Williams' "Vulcan" Drop-Forged Safety Lathe Dogs merit special mention. Their design provides safety—absolute and unqualified because automatic—for the operator, with maximum strength and better balance on the lathe. For extreme service, they are made with two screws. Dogs can be furnished with projecting squarehead screws, but these destroy the safety feature. Bent and Straight Tail Patterns, 16 Sizes, ⅜ to 6 inch capacities.

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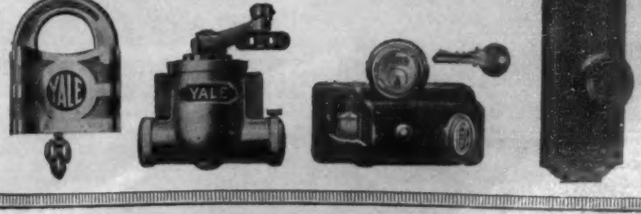

If the great war had been fought in George Washington's time

Of all the military problems that confronted George Washington there was none greater than that of feeding his armies.

Meat, the fighting man's most important ration then as now, was especially hard to obtain. Much of the time his soldiers had to depend for sustenance on what they could get by foraging.

* * *

America's job of meat supply, in the great war just ended, was a thousand-fold bigger than Washington's. It was a job of feeding not only our own huge forces here and abroad but the Allied armies as well.

America succeeded because she had at her command what Washington didn't have—thousands of prosperous farms and *centralized large-scale organizations like that of Swift & Company for the production and distribution of meat.*

How well America succeeded, how well her meat machinery stood the test, is evidenced by a French military authority who not only said that France could not have held out without our support, but asserted that "the men over there in the French trenches are the best-fed men in Europe."

To give some idea of the immensity of the food problem—Swift & Company in one single month shipped 2,012 carloads of provisions overseas, valued at $31,268,000.

If America had been dependent on the meat supply methods of Washington's time, or even of Civil War time, it is not difficult to imagine what would have happened.

Speaking along this line, an American official said that it would have been a super-human task to gather and handle the meat necessary to feed the people during this great war if conditions had been the same as they were "during the Civil War, when the meat industry was scattered all over the country."

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NEW BOOKS, ETC.

THE A-B-C OF AVIATION. By Captain Victor W. Pagé, Sig. R. C. Aviation Sec. New York: Scientific American Publishing Company, 1918. 8vo.; 385 pp.; illustrated. Price, $2.50; by mail, $2.60.

Schools of aviation were so impressed with the value of the author's treatise on "Aviation Engines" that there was an insistent demand for an exposition of the airplane itself, written in a like simple and nontechnical way. In response, Captain Pagé has prepared "The A-B-C of Aviation" and it reaches the public carrying the commendation of both military and civilian instructors. While the abstruse details of engineering designing problems are left severely alone, the student may learn from it as many of the basic principles of flight as it is necessary for the practical man to know; it presents in clear outline the elements of aeronatical engineering, with simplified explanations of the theory of flight, aerodynamics, and the fundamental principles governing the action of balloons and airplanes of all types. Not until these basic facts are fixed in the mind of the student does the work proceed to show in detail the different parts of an airplane, the coordination between these parts, and how they operate together to produce results; all types of airplanes, with their characteristic differences in construction, are described and pictured, with the advantages and disadvantages of each type strongly brought out; instructions for unpacking, setting up, and rigging are given and there is a full description of control principles and important hints on flying methods. The author is supremely qualified to guide the beginner by pleasant paths to a mastery of the subject of aviation, as those familiar with his former works will be the first to admit; besides being a pioneer aeronautical engineer and expert, his experience as instructor at Government Flying Schools has made him intimately familiar with the questions that arise in the student's mind, and all such questions have their plain answers in this invaluable handbook; very often the answer is found in a glance at one of the 130 specially made illustrations and diagrams that place the machines and their constructional and operational principles squarely before the eye. The usefulness of the work is not confined to the classroom for as a self-educator it is so understandable and thorough as to be unequalled by any other work in its field.

AIRPLANE CHARACTERISTICS. By Frederick Bedell, Ph.D. Ithaca, N. Y.: Taylor and Company, 1918. 8vo.; 130 pp.; illustrated. Price, $1.75.

The author codifies the known ground work of this subject for the benefit not only of flyer and designer, but also of the student and general reader who is interested in aviation. Vital principles and accepted practice are expounded without the use of higher mathematics, and without courting the charge of superficiality on the one hand or obscurity on the other. Those who wish to acquire a knowledge of essentials in as short as possible a space of time will find the text well suited to their needs; it does not attempt to discuss military use of the airplane, or the materials of construction, or the engine, but confines itself to sustentation, stability and characteristics.

MANUAL OF MILITARY MAPS. By Lieut.-Col. J. M. Hutchinson, U. S. A. and Capt. A. J. MacElroy, U. S. A. New York: D. Appleton and Company, 1918. 16mo.; 129 pp.; illustrated. Price, 75 cents net.

Such officers and non-commissioned officers as have had little acquaintance with military map making and reading will find here simple statements of fundamental features and essential facts that will enable them to sketch and read with accuracy and facility. Such elements as direction, distance, configuration and elevation are presented in an interesting manner with the aid of drawings and diagrams.

THE AMERICAN BOYS' ENGINEERING BOOK. By A. Russell Bond. Philadelphia and London: J. B. Lippincott Company, 1918. 8vo.; 309 pp.; 232 diagrams by Edwin F. Bayha. Price, $2.00.

Tools and a workshop and something fascinating to make—these are at any time sufficient to make up a real boy's Paradise. In this capital book for boys the author shows how an old bicycle may be turned into a foot-power grinder, and the grinder fitted with a scroll attachment. The young mechanic may acquire a drill press, lathe and forge about as easily. Then he is ready to make telescopes, rafts, cableways, gravity railways, and water power machinery, ollowing the clean-cut instructions and drawings here furnished. The work will do far more than to develop manual dexterity; the boy's insistent "Why?" is answered by chapters on the wonders of the heavens, surveying, sounding and signaling, roads and railroads, navigation, wharves, bridges, building construction, and the Weather Bureau. It is a full feast for the boy of energy and initiative.

THE COMPOSITION OF CERTAIN PATENT AND PROPRIETARY MEDICINES. Compiled by John Phillips Street. Chicago: American Medical Association, 1917. 8vo.; 274 pp. Price, $1.25.

It is right that physicians and pharmacists should know the make-up of "patent" medicines; and since the public spends $150,000,000 a year on them, it would seem but fair to let the average man know just what he is getting; meritorious compounds would not suffer. Major Street, until recently Chemist in charge of Analytical Laboratory, Connecticut Agricultural Experiment Station, has brought together from scattered publications more than 2,500 remedies and 3,100 analyses; these are given "without comment and without prejudice," and the accuracy of the record may be relied upon.

AEROPLANE CONSTRUCTION AND OPERATION. By John B. Rathbun. Chicago: Stanton and Van Vliet Co., 1918. 8vo.; 426 pp.; illustrated. Price, $2.00.

Written by an aeronautical engineer who has had long experience in teaching, this text is neither a popular, superficial description of aircraft nor a technical treatise understandable only by the trained engineer; the serious student of the subject, whether he aspire to be aviator or constructor, will find in it a progressive exposition in plain language, beginning with elementary principles and proceeding to complete calculations for surfaces, power, and weight. The mathematics are simple, tables take the place of complicated calculations, and the work is adapted either for home study or in the schools. Mechanics, designers and flyers will discover in its pages the answers to most questions that arise in the mind of the student, with a concise but intelligible and accurate treatment of all phases of construction and operation.

HIGH SPEED INTERNAL COMBUSTION ENGINES. By Arthur W. Judge, A.R.C. Sc. New York: Isaac Pitman and Sons, 1918. 8vo.; 359 pp.; illustrated. Price, $7.20.

The recent rapid development of the high speed internal combustion engine has left the book literature of the subject somewhat in arrears; a British author here endeavors to remedy this situation with a work devoted exclusively to this type. He has selected the most important results, both theoretical and experimental, for careful analysis, has arranged these results and analyses in an orderly manner and, realizing the influence of experimental work upon design, has added a chapter on the methods of measuring the pressures in the cylinders of high speed engines. Other chapters deal with the conditions occurring in actual engines, the mechanics of the high speed engine, and engine balance. The volume collects and classifies very important information that might not otherwise be readily available.

LIBERTY RECIPES. By Amelia Doddridge. Cincinnati: Stewart and Kidd Company, 1918. 8vo.; 106 pp.; illustrated. Price, $1.25 net.

The war is over, but the necessity for conservation is still with us. "Liberty Recipes" is a meritorious collection of suggestions and recipes for prepared dishes that are highly palatable and at the same time conserve wheat, meats, fats and sugar. The work will greatly aid in the planning of menus and in adapting old family recipes to present ideas and necessities.

OUTLINES OF THEORETICAL CHEMISTRY. By Frederick H. Getman, Ph.D. New York: John Wiley and Sons, Inc., 1918. 8vo.; 553 pp.; illustrated. Price, $3.50 net.

This is a second, revised and enlarged edition of an introductory text that has been in demand for the past four years. Among other amplifications and additions may be noted new material on radioactive phenomena and the modern conception of the atom, the bearing of X-ray spectra on crystalline form, colloidal phenomena, the Brownian movement, electromotive force, and photochemistry. The work is well adapted for classes passing from elementary chemistry and physics to theoretical or physical chemistry.

EXPERIMENTS. A Volume for All Who Are Interested in Progress. By Philip E. Edelman. Minneapolis, Minn. Philip E. Edelman. 8vo.; 256 pp.; illustrated. Price, $1.50.

This is a concise but comprehensive account of experimental work in science, the industries and the amateur field. Book 1 consists of selected, grouped and graded experiments, easily repeated, in physics, chemistry, electricity and mechanics, while Book 2 presents the principles of original experimenting in science, invention and the industries. The working directions are illustrated with tables, plates, engravings and half tones.

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